LIGHTNING—SOME OF ITS EFFECTS*

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Every action, chemical or physical, within the universe is accompanied by the generation of electricity.

Atmospheric electricity is generated by the friction of the wind and currents of air upon the vapor in the atmosphere, and by the molecular changes in this vapor, whereby they are converted into positive and negative electric ions (*Scientific American*, No. 106). The generation is more active when the vapor temperature is raised by the heat of the sun and later cooled by currents of air (*Scientific American*, No. 625; Henry, *U. S. Bulletin*, No. 30).

The earth is in a state of permanent electrification. The vapor in the atmosphere in condensing forms clouds, which in passing over other clouds and over the earth become charged by induction with electricity of opposite polarity to that of the earth.

Under ordinary conditions electricity in the atmosphere is neutralized by the insensible interchange with the electricity of the earth. This takes place in the form of usually invisible discharges, from the top of every mountain, hill, building, tree or metallic object. Discharges of this character take place from the human body, and when in high altitudes or on mountain peaks it may cause muscular rigidity and discomfort.

The electrical tension of the atmosphere may become very great. When the charges attain sufficient intensity that insensible neutralization becomes inadequate, the insulating air space is broken. The charges rush together and neutralize each other by a series of flashes, accompanied by the generation of light, heat and sound. Lightning is the term applied to this visible discharge of electricity.

The zone of danger may extend beyond the storm area (*Sc. Am.*, No. 625). Any upright or prominent object, being a better conductor

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of electricity than air, is liable to be struck. The electrical strain is taken up by every object in contact with the ground in proportion to its conduction and insulation.

Guerike, in 1650, was the first to discover the means of producing the electric spark (Flamarion). Nothing was known of the nature of lightning or of its relation to electricity until 1708, when Wall drew attention to the similarity of lightning and the sparks obtained by rubbing a piece of amber. Franklin in 1750 proved that the atmosphere was constantly in a state of electrification and with others demonstrated that lightning and electricity are identical. The degree of atmospheric electricity increases with the distance from the surface of the earth (Flamarion).

Lightning tends to obey the laws governing electricity. It is of such incomprehensible strength and the factors incident to its development are so imperfectly understood, that the laws controlling its dissipation have not been fully determined.

A flash of lightning is a rapid succession of (15–40) distinct sparks (1/5000 to 1/500 second duration) of progressively increasing length, projected along the same general path. The succession of sparks gives to lightning its flickering appearance. The entire flash varies from 1/1000 to ½ second duration.

The direction of the flash is a matter of dispute. It may take place to or from the earth.

The discharge usually takes place between the most prominent or proximal points. It follows the line of greatest conductivity or of least resistance. The charge may be so great that the main path is insufficient for its conduction. It may jump out of the main course, or form numerous branches (*Sc. Am.*, vol. 80). The course taken is determined by the intensity of the current and by the conduction or resistance encountered. The path may be altered by the wind or by the hygrometrical state of the atmosphere (Flamarion). These conditions account for the sinuous, spiral or irregular appearance of lightning.

Unsuccessful attempts have been made to determine the current-intensity, the frequency and the amperage of lightning. These have been variously estimated—voltage as high up in the millions (5000 millions). The frequency as medium (5000 to 300,000, *Emede Sc. Am. Supp.*, No. 697). The amperage upward of 10,000 (Brockels).

So long as resistance is not offered lightning is harmless (*Virchow's Archives*, vol. xx). Lightning will leap over a non-conducting surface

more readily than through air. Insulation afforded by auto tires, etc., and the safety thereby conferred is a fallacy (*Sc. Am.*, November 7, 1914). *Protection does not lie in providing insulation or resistance, but in establishing a path of greater conductivity and of less resistance than the body.* Conducting bodies or objects are more liable to be struck but are damaged less than resisting bodies (*U. S. Bull.*, No. 56).

There is an uncertain periodicity associated with the frequency and the severity of electrical storms. They are more frequent in the temperate zones during the summer months and in rainy seasons. They are five times more frequent east than west of the Rocky Mountains, more frequent in high mountains and on open plateaus than along the coast, or in low altitudes, in wet, marshy districts more than in dry districts.

The geologic as well as the topographic character of a region exerts an influence upon the site and the severity of a lightning stroke (*Sc. Am. Supp.*, No. 24; *U. S. Bull.*, No. 15). Loam, sand, clay, marl, and chalk predispose in the order named. Rocks are not often struck. They may be split, moved in great masses, or their surface vitrified. Fulgurites may be formed when lightning strikes dry soil rich in silica. Any tree may be struck, in order of their frequency, poplar, oak, elm, conifer, walnut, ash and beech. The richer in starches and the poorer in oils the more susceptible are trees. When struck the tree may be split, separated into layers, splintered, broken off obliquely or transversely. It may be stripped of limbs or bark. The bark may be grooved vertically or spirally, may be ignited (2 per cent.), may be stunted or stimulated in its growth.

Buildings are susceptible in proportion to their size, height, nature of their construction and insulation.

Lightning is more frequent (five times) in rural than in urban districts. The more thickly settled and the better built a section is, the less frequent and destructive will be the lightning.

Occupations which keep one in the open, especially in sparsely settled or open districts, increase liability—cattlemen, woodmen, farmers, etc. Animals are more frequently struck than men. All species, even fish in ponds and streams, have been affected. When animals are struck they rarely survive.

No accurate statistics of lightning casualties are available. Most fatalities and the greatest property damage occur during the months of June and July. The largest number of deaths occur in the Mid-Atlantic states. The greatest proportionate mortality is noted in the

mountain states of Colorada, Montana and Wyoming. Over sixteen hundred cases of lightning accidents are recorded yearly in the United States. One-third of these result in death. Nine-tenths of the deaths occur in rural sections.

Lightning has a tearing or explosive effect. It has a greater tendency to bend or break than to burn or fuse. The effects are largely mechanical, the result of pressure fluctuations. The disassociation of gases (*Virchow's Archives,* vol. xx) or the generation of steam by the current are claimed to explain many of these mechanical effects (*Lancet,* 1879-1909). The charge in passing through the body is not evenly distributed. It may remain superficial, follow channels, such as blood- or lymph-vessels, or be transmitted through bones and nerves.

The body may not be visibly affected, may be left in the same posture as before the stroke or thrown more or less violently many feet, and not injured (*Lancet,* 1909, vol. 1). Mutilation in varying degrees to complete dismemberment or incineration may result.

The clothing may not be affected in any way. It may be stripped or burned in part or entirely, shredded to ribbons, either warp or woof may be destroyed. Seams may be ripped, linings or undergarments destroyed leaving the outer garments and the skin intact (Flamarion). Metallic objects in or of the clothing are bent, broken, more or less fused or not affected. The shoes most constantly show the effects of the current. People are usually standing when struck, the current then enters or leaves the body through the feet. The shoes, especially when dry or only partially damp, interpose a substance of increased resistance. One or both shoes may be affected. They may be gently removed, or violently thrown many feet, be punctured or have a large hole torn in any part, shredded, split, reduced to lint or disappear entirely. The soles may disappear with or without the heels. Any of the foregoing may occur and the person not injured or only slightly shocked.

The amount of damage to the clothing or to the surface of the body is no index to the extent or the severity of the injuries sustained within the body. Either may be disproportionately great or small.

As lightning travels faster than sensory impulses, or the tracts are blocked, the injuries at the time of their infliction are usually painless.

The symptoms may be divided into (1) external or mechanical, (2) internal or essential, (3) mental or psychical.

External or mechanical signs are most marked at the points of

entrance or exit of the current. The nature of the injuries is determined by the position of the body, the condition of the skin, the character and condition of the clothing, the presence of constricting bands of metallic parts and the proximity of conductors and contacts.

The skin offers greater resistane than any other tissue. The resistance is five hundred times greater when dry or oily than when wet. This difference accounts for the wide variation in the character and degree of its injuries, which are burns, lacerations and contusions.

Burns range in degree, from singeing of the lanugo and mildest erythemas to complete incineration. They vary in extent from minute punctate to extensive irregular areas. Burns which at first appear small and superficial may later assume a more extensive and deep character. They may partially heal and later break down, not only in the scar but in the adjacent apparently healthy tissue. They take longer to heal than ordinary burns.

Erythema may be the only manifestation of lightning stroke, or may accompany burns—as a circumscribed area or as irregular, narrow or broad, more or less branching bands—the resemblance to trees, ferns, etc., giving rise to the popular fallacy of lightning photographs. It has been asserted that these peculiar configurations are due to vasomotor paralysis, and to disintegration of the blood in the superficial vessels and capillaries. They are not confined to the distribution of these vessels. Rindfleisch (*Virchow's Archives*, vol. xxv) proved they are due to the effect of the current on the tissues, the irregular and branching distribution being caused by the difference in resistance.

Vesication and pigmentation may accompany burns and erythemas as brownish areas, hard dry parchment-like or soft, with vesicles containing more or less altered blood.

Contusions, from the mildest, with slight ecchymosis, to the most severe degree, with extensive hæmatomas, may occur.

Lacerations may be single or multiple, clean cut or irregular. They may be superficial, confined to the skin, or deep, involving not only the subcutaneous tissues but also the muscles, fascias, vessels, nerves and bones. Either may be extensively involved without the other.

Joints may be dislocated, bones may be fractured. Fractures are direct, caused by the lightning, or indirect, due to muscular contraction, the throwing of the body, or by objects falling on the body. When direct they are usually comminuted or complex and occur at joints, particularly where several bones enter into the formation of the joints, *e.g.*, ankle and spine. A break in the continuity of the bony tract

conducting the electric charge increases the resistance and admirably illustrates the law—damage is in proportion to the resistance.

Important vessels may be ruptured, cause alarming or fatal hemorrhage or irreparable damage. Any viscus may be lacerated or ruptured with or without damage to the overlying tissues. Eye injuries may result promptly in cataract. The choroid or choroidal vessels may be ruptured, retinal hemorrhage or detachment, paralyses of the muscular apparatus and of accommodation or atrophy of the optic nerve may occur (*Medical News*, 1888). Ear may be torn off, membrana tympani ruptured, or the auditory nerve injured.

The actual destruction of tissue resulting from the purely mechanical effects is of secondary importance, so far as life is concerned, to the interruption or the destruction of the physiology of the vital centres. This pathological physiology explains many of the internal or essential symptoms.

The internal or essential symptoms may be divided into primary and secondary.

Primary symptoms may be very slight: a mild sensation of giddiness or blunting of intellectual faculties. Loss of consciousness more or less complete, lasting from a few moments to days, may terminate in death. Return to consciousness may be sudden or by stages. Collapse with pale clammy skin, difficult, slow and irregular respiration, irregular feeble pulse, dilated pupils, may enter a state of suspended animation, during which there is neither respiration nor pulse. This lasts a variable period, usually short and if not promptly treated by artificial respiration deepens into death. Lastly and most awe-inspiring is instantaneous death without macroscopic lesion.

Secondary symptoms are in all probability dependent upon some tissue change. Loss of memory complete or confined to the accident, temporary or permanent. Aphasias of any kind may result. Growth of the affected part may be permanently stunted.

Motor.—Tonic or clonic contractures, rhythmical or irregular, general or confined to the injured part. Paralysis—mono, hemi, para or quadriplegia with or without involving the sphincters. Difficult mastication, deglutition or phonation. Vertigo, ataxia or loss of coördination. Convulsions, true epilepsy or epileptiform.

Sensory.—Pains, general or confined to the area affected, sharp, severe darting or paroxysmal in character or a dull ache. Hyper, para or anæsthesia.

Special sense—deafness, dulling of hearing or buzzing in the ears.

Blindness, blurring of vision, double vision, loss of color sense, lachrymation, photophobia, ptosis, loss of accommodation.

Mental or psychical neuroses may have a pathological basis. Functional traumatic neuroses, mental or intellectual impairment, insomnia, delirium, mania. Hypersensitive to electrical storms ranging from fear to positive pain.

Prognosis should always be guarded. When symptoms have no demonstrable pathological basis they are usually temporary but may last for months. Death may be instantaneous, a direct effect of the lightning upon the myocardium (fibrillation) or upon the respiratory centre, or both; more or less sudden, due to shock following the stroke or to gross lesion of the vital centres; slow, from delayed shock of the injuries, as a direct result of the injuries or consequent exhaustion.

The diagnosis of death due to lightning depends upon the presence or absence of positive findings at autopsy and upon the conditions and circumstances attending the finding of the body at the site of the accident. The post-mortem changes may be negative. Evidence of violence may be entirely absent. Body temperature may be elevated for a considerable period. Rigidity sets in early and passes rapidly. Putrefaction may set in early and progress rapidly.

Brain and nerve tissue being better conductors are more easily affected, but show less macroscopic damage than other tissues.

Findings may be those of asphyxia, congestion with or without ecchymosis of the cerebrum medulla or cord and their membranes. Heart is flaccid, right heart filled with fluid blood, the large venous trunk and veins congested, arteries contracted and nearly empty. Blood not coagulated or poorly coagulable. Ecchymosis beneath the pericardium, pleura or in the lungs. Evidence of violence or injuries before mentioned in the skin, muscle, bones or viscera. There are no reliable or constant cytologic changes in the material obtained from cases of death by lightning.

CASE I.—On August 3, 1916, Miss V. and Miss A. were sitting on the porch of their cottage which was located among the pine trees on the slope of a hill near Grand Lake, Colorado. A severe storm began and they went into the cottage.

Miss V., noticing the rain coming in the window of her room, closed it, but not before the floor became wet. She then sat on a commode. The commode was several feet from the bed near the living room partition, on the opposite side of which was a

stove with a metallic flue leading through the roof. The next thing she knew she was lying partly under the bed near a large hole in the floor. She experienced no pain, did not know what had happened or how long she had been unconscious. She says it could not have been long, probably a few minutes. When she tried to get up she noticed the front of her shoe was torn and the sole and heel entirely gone. The little toe was gone and her foot was bleeding badly. She called to Miss A., but received no response.

Miss A., who had been sitting in a chair near the middle of the living room, heard Miss V. close the window and remark about the storm. She heard nothing after this, but saw the stove lid fly across the room and heard it fall on the floor. Above the stove appeared a huge round flash of bright light the size of the sun. She tried to get up but was lifted from her position and thrown several feet through the open door to the floor of her room. She was dazed, her ears felt shut. She was aroused after a brief period by the cries of Miss V, which she heard as if in a dream. She could not move. By supreme effort, being unable to get up, she crawled to Miss V's room and found her sitting on the floor holding her foot. The sight of blood all over the floor brought her out of her dazed condition. She laid Miss V. on the floor, who on looking up through a hole torn by the lightning in the ceiling saw the cottage was on fire. The cottage burned completely. The nearby pine trees were also burned. Miss V. was carried to the adjacent ranch house and attended by Dr. H. L. Buxton who rendered efficient service, stopping the hemorrhage which seemed to threaten her life. Her watch stopped at 2.10 P.M., the exact time of the stroke.

I was sent to Grand Lake by Dr. G. W. Holden, and arrived the next A.M. Miss A. was entirely recovered though still very nervous, a state easily accounted for by the precarious condition of her friend Miss V. Miss V. was in a state of shock, under the influence of opiates. Lips cyanotic, skin pale, giving face a peculiar expression. Pulse 140, respiration 14 and irregular. Her left labia showed a superficial laceration the size of a quarter. Her left foot had a laceration, the surface of which appeared as if seared by heat, extending through the web between the big and second toe from the dorsum to the plantar surface of the foot back to and exposing the first row of tarsal bones. A second laceration through the web between the second and third toe through the entire thickness of the foot joining the first laceration near the base of the metatarsal bones. A third laceration 2 inches long through the web between third and

Fig. 1.—Internal aspect.

Fig. 2.—External aspect.

FIG. 3.—Comminuted fractures resulting from direct explosive (lightning) violence.

Fractures

Traumatic
amputation
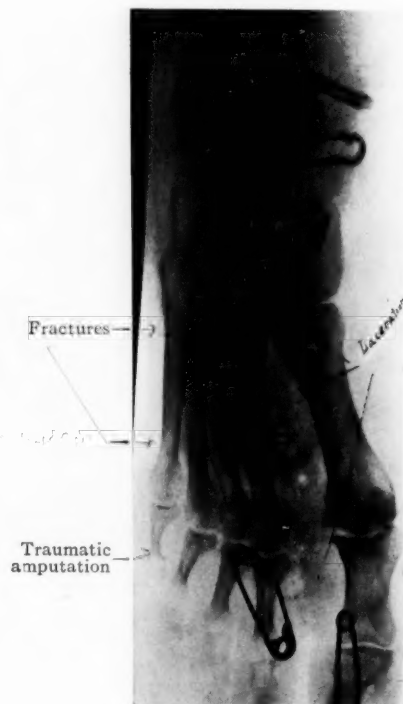
FIG. 4.—Extensive laceration through entire foot, exposing the tarsal bones, illustrating explosive
or tearing effect of lightning.

fourth toe involved the dorsum of the foot and the intermeta-tarsal tissues. A fourth laceration through the web between the fourth and fifth toes extended across the base of the little toe, completely amputating it, leaving only a fragment of the proximal phalanx. On the dorsum of the foot near the base of the second and third toes was a nearly circular burn of second degree the size of a silver half dollar. On the corresponding area of the sole was a burn of the same size and degree. Extending from two inches below the internal malleolus under the heel to its outer margin was an irregular laceration through which could be felt fragments of the fractured os calcis. One of these fragments had the posterior end of the badly shredded plantar fascia attached to it; two others were removed. There was a comminuted fracture of the lower end of the tibia and fibula, compound comminuted fracture of the os calcis and fracture of the third and fourth metatarsal bones, as shown on the accompanying X-rays by Drs. Childs and Crosby.

Without anæsthesia the wounds were gently wiped free of coagula with dry gauze. The plantar fascia which was reduced to a bundle of strings and the deeper tissues were united by tiers of interrupted catgut sutures, two catheter drains inserted, skin loosely approximated with interrupted silkworm sutures, leg placed on posterior splint. Patient withstood the ordeal with wonderful fortitude. She was sent to Denver the next day. For three days her temperature was 100, but never higher. She had severe darting pains in her back, leg and foot. Tactile sensation in foot and leg was normal. At the end of a week I sent her to her home in Chicago and reports tell of her favorable progress. She can now bear considerable weight on her foot which is practically healed.

SOME OBSERVATIONS IN SPINAL CORD SURGERY

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Unusual possibilities for the prolonged observation of the effects of spinal cord lesions, principally traumatic ones, and the effects of various operative procedures upon such lesions, exist in two surgical services to which I am attached. For the unlimited opportunity to study and operate upon these cases, I am indebted to Dr. Darrach, Director of the First Surgical Service at Bellevue Hospital, and to my colleagues on that service, and to Dr. Elsberg, Attending Neurological Surgeon of the Central and Neurological Hospital. The observations to be made are grouped under various captions; some of these are related but are separately presented to bring out certain points.

FASCIA TRANSPLANTATION INTO DEFECTS OF THE SPINAL DURA

The problem of dealing with large defects of the dura, the necessary result of its sacrifice at operation, has not been adequately solved. When, for example, a large part of the posterior surface of the exposed dura must be excised because a tumor springs from it, suture of the defect in the ordinary manner may be difficult or impossible; even if the defect can be closed, the procedure is undesirable in such instances because of the resulting constriction of the cord. The latter holds true although no evidence of pressure upon the cord may be noted at the operating table. For it must be borne in mind that the considerable space normally existing between the dura and cord exists in part for the purpose of allowing free motions of the spine in all directions. In short, I believe that whenever a large defect is the result of the operative procedure or disease, the dural defect should not be closed by suture of its margins.

Some surgeons do not make any suture of the dura under such circumstances, but rely upon an accurate closure of musculature and aponeurosis in order to prevent leakage of cerebrospinal fluid. Besides the fact that this does not give absolute assurance against leakage, this technic is objectionable because adhesions between the cord and the adjacent sutured musculature must inevitably result. Others cover the defect with Cargile membrane, which is expected to remain securely in place and about which adhesions are not supposed to develop.

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Neither of these assertions has been proven to be correct for the spinal canal as far as I can determine. Whatever clinically satisfactory results follow such treatment of spinal dural defects depend, I believe, upon the careful approximation of the layers of the wound, and not from the implanted animal membrane.

Experimentally and clinically, defects of the *cerebral* dura have been adequately replaced by free autoplastic transplantation of fascia lata. In a series of experiments I was able to demonstrate that defects of the spinal dura can be treated in the same way. In fact, fascia transplantation in the latter region was found to have distinct advantage over its implantation into the cerebral dura, for, in contrast, adhesions between the transplant and the underlying cord were not observed even after prolonged periods (more than one year). It is interesting to note that in these experiments the inner surface of the transplant sutured into a defect of the spinal dura remains smooth, and becomes lined with a layer of flat (mesothelium-like) cells continuous with the dural lining, and that the transplant becomes converted into an equally strong resistant layer of altered connective tissue.

The correct clinical method of treating large defects of the spinal dura, therefore, appears to be by transplantation of fascia. The latter (aponeurosis over the erector spinæ) is close at hand in spinal operations and the sacrifice of the necessary part for transplantation purposes is harmless. In reference to the technic to be employed, it may not be out of place to call attention to the fact that, as I have shown, the chances for the success of a fascial transplant into a visceral defect are far greater and more uniform if the transplant is sutured into and not over the defect. The technic and the result of the fascia transplant into the spinal dura are given below in the one instance in which I have had the opportunity to employ the procedure.[1] It will be seen that there was no leakage of cerebrospinal fluid (although the layers of muscle that could be approximated over the transplant were unusually thin and atrophic) and that no untoward effects from the transplant are to be observed at a considerable period of time after the operation.

Ellen C., fifty years old, was operated upon for post-traumatic deformity of the lower dorsal spine (Kuemmell's disease, reported in detail in another place) in the Central and Neurological Hospital, in March, 1916. The musculature on either side of the very marked deformity was pale and atrophic. After removal of the

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[1] A second case in which it was employed is too recent to give final results; the immediate outcome was very satisfactory.

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spines and laminæ it was evident that the sharp angulation of the vertebral bodies produced a similar angulation and compression of the cord with its membranes. As soon as the dura was incised its edges separated and the posterior surface of the cord projected into the gap. The purpose of the operation—relief of pressure on the cord—would evidently have been negated if the dura were resutured.

The erector spinæ aponeurosis was exposed and its glistening surface carefully laid bare for the required distance. Avoiding undue handling, the under surface of the portion to be excised was gently separated from the muscle. An elliptical section, 5 × 1½ cm., was then removed and turned with its superficial surface towards the cord. Four fixation sutures of fine silk, one on each side and two at the ends, approximated the cut edge of the dura to the margin of the transplant. A continuous suture of fine silk was then used to approximate the dural and fascial margins all around. The spaces between the stitches averaged about ½ cm., the sutures not being drawn very tight. In closing the wound it was evident that the two layers of muscle, usually found thick and amply protecting in laminectomies, afforded a thin covering for the transplant, so that it was clear that if leakage of cerebrospinal fluid occurred the fluid would appear under the skin or on the surface. The aponeurosis and skin were closed with interrupted sutures in the usual way.

The post-operative course was uneventful; there was no evidence of escape of cerebrospinal fluid. The wound healed firmly, and is at the present time (one year after operation) free from any untoward manifestations. Lumbar puncture recently made yielded fluid under normal pressure.

THE OPERATIVE TREATMENT OF RECENT SPINAL CORD INJURIES:
INDICATIONS AND CONTRA-INDICATIONS

It is almost universally agreed that the present-day surgery for complete crushes of the spinal cord is quite hopeless, and that such cases should therefore not be operated upon. A difficulty, however, rests in the differentiation of acute œdema, accompanying various lesions, from total destruction of the cord. The small minority of surgeons, arguing that it is not always possible to distinguish between these conditions, believe that operations should be performed in the hope that œdema will be the lesion found. They maintain that its relief by appropriate incisions of the cord may prevent total destruction. It has not been demonstrated clinically, however, that the diffuse œdema of the cord tissues can thereby be relieved, and it has not been

proved, nor is it clear from our knowledge of the pathology of œdema, that such destruction must necessarily occur without incision of the cord. On the contrary, the many reported cases of total paraplegia following cord injuries in which improvement or even complete relief has supervened without operation must, in the absence of more precise knowledge, be considered instances in which œdema was an important part of the pathological condition.

There is far less uniformity of opinion as to the operative indications for the varying degrees of injuries to the cord short of complete destruction. The more radical view urges operation for this group of cases in the expectation of removing fragments of bone pressing on the cord, straightening out angulations, etc. The indication for operation, according to the conservative standpoint, may be summed up in the statement that it exists when there is progressive increase of the manifestations of the cord injury. Put in another way, one should wait, according to the latter view, for evidences of increasing damage to the cord; according to the former view, one should not wait to see if the patient will recover more or less completely without operation.

In reading some of the voluminous literature upon the subject, I could not arrive at a conclusion as to the indications for operation more definite than that I have given. It is futile to dismiss this important question by stating that it depends largely upon personal experiences, varying technical ability, etc. There has been ample opportunity to observe the results obtained by various surgeons, and, though operative technic unquestionably plays an important rôle, it appears to me that they depend much more directly and definitely upon the operative indications that had existed. I shall present a number of reasons for assuming an extremely conservative stand for surgical interference in spinal cord injury, and then offer two indications for operation:

1. In the great majority of cases, whatever damage has been done to the cord cannot be undone by operation. Fragments of bone that have bruised or lacerated the cord have in many instances sprung back so that it is rare to find, at operation, a fragment of bone actually pressing upon the cord. Not a few cord injuries exist either in the absence of a demonstrable fracture or with fissure fractures of the vertebral bodies and laminæ.

2. On operation, partially or completely detached fragments of bone are often found here and there in the musculature. Particularly in the cervical region, some of these have helped to support the injured part of the spinal column and their necessary removal for exposure of the cord means that much greater possibility of collapse of the spinal

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column. This is especially the case when the bodies of the vertebræ are considerably damaged; and even more so when an extensive injury is confined chiefly to the bodies.

3. The difficulties in immobilization after operation are enhanced because of the necessary removal of spines and laminæ, and are increased in proportion to the amount of bone removed. It becomes a problem to determine the exact position in which the spine should be fixed. This holds true particularly in the cervical region. As an illustration of the difficulties in immobilization, the following case may be mentioned:

A patient admitted to Bellevue Hospital was suffering from extensive fractures of the laminæ and bodies of the fifth and sixth cervical vertebræ, with the evidences of compression of the cord at those levels. At operation the loose fragments of bone were removed and the cord was found not to be directly compromised by them. The only visible evidence of injury to the cord was a patch of œdema. After closure of the wound, a posterior plaster-of-Paris moulded splint was applied. There was gradual improvement in the manifestations of the spinal cord injury until the fourth day after operation. Evidences of progressive loss of cord function then supervened. The splint was removed. It was found that it had slipped upwards slightly, this resulting in some abnormal flexion of the head. When the head was permitted to fall back in a more normal posture, the manifestations promptly receded.

4. The important muscular support given the spinal column by the erector spinæ must be greatly diminished by operation, because of the necessary division and retraction of the muscles for exposure of the operative field and the subsequent temporary paresis or paralysis.

5. The preparations for operation and the immediate post-operative immobilization are all fraught with danger of additional damage of the spinal cord out of proportion to what can actually be done for relief in most cases, it seems to me. The patient must be transferred from bed to stretcher and operating table, and distortions of the spinal column may thereby result. He may struggle during anæsthetization, and this may result in further injury. It is necessary to roll the patient to the prone posture on the operating table, and loose fragments may as a result be pressed against the cord; this holds particularly, I believe, for the necessary fixation of the head for cervical laminectomy.

6. The operation itself is unquestionably an added danger, for

patients are often not in good physical condition for many evident reasons. The operative mortality must, therefore, be considered in counterbalancing the possible relief that may be given.

7. Typical laminectomy cannot be carried out in many cases because the landmarks are so often greatly distorted. In not a few instances the position of the cord can only be guessed at. As a result, it may be further injured in the removal of loose fragments of bone, and in the other procedures required for its exposure.

8. The primary manifestations of severe cord injury may clear up in great part without operation; similarly, the residual evidences of a mild injury to the cord can certainly be very slight indeed.

9. The immediate after-effects of laminectomy must also be considered. The patient requires a more prolonged stay in bed because of diminished support to the vertebral column when the bodies of the vertebræ have been fractured, and complications therefrom (pressure ulcers, anæmia, etc.) must be borne in mind. Furthermore, the after-effects of operation may consist in a definite weakness of support of the spinal column.

The question of indication for operation is, of course, entirely different when, after adequate observation, it is evident that the improvement in the primary condition has progressed as far as possible. The persistence of such symptoms as severe pain, spasticity, etc., may call for operation in the secondary stages. I wish to call attention to two definite indications which I believe are the only ones that call for operation for fresh spinal cord injuries in civil practice at the present time:

1. Progressive intraspinal hemorrhage as indicated by repeated lumbar puncture.

2. Unquestionable X-ray demonstration of a fragment of bone encroaching upon the spinal cord at the level to which the neurological manifestations point.

Neither of these is an absolute indication for operation if the manifestations of cord compression are not severe.

THE LIMITATIONS OF RÖNTGENOGRAPHY IN THE DIAGNOSIS OF SPINAL INJURIES

The great value of X-ray examination in spinal injuries is too well known to require any discussion. In not a few instances, especially when mild traumata have been inflected, it alone establishes the existence of a fracture of one or more of the integral parts of the vertebræ. It is not so universally recognized, however, that injuries of the con-

tents of the spinal canal not infrequently exist in the absence of any lesion demonstrable by röntgenography. I do not refer to dislocations, chiefly to the cervical vertebræ, in which it is presumed that reductions have spontaneously occurred, but to cases in which there is undoubted evidence of injury within the dural sac (as shown by the presence of blood in the lumbar puncture fluid and neurological manifestations referable to a definite cord level), particularly of the dorsal and lumbar regions. Repeated X-ray examinations, with the tube squarely focussed on the suspected vertebræ, have in such cases failed to reveal any abnormalities even when exceptionally clear röntgenograms were obtained. It is not within my province to inquire if this fact is referable to the limitations of technic or to the absence of any fracture, although I believe that most röntgenologists will concede that fissures of the bodies of the dorsal or lumbar vertebræ may not show in the X-ray plate. My purpose is only to emphasize the fact that a negative röntgenogram by no means excludes the existence of an intradural injury. The following case is a striking example:

A man was admitted to Bellevue Hospital with the history of having fallen from a stoop, landing on his back, twenty-four hours before. The neurological evidence pointed to a lesion of the spinal cord, of an irritative rather than a destructive type, opposite the tenth to twelfth dorsal vertebræ. Lumbar puncture revealed considerable blood. Repeated X-ray examinations of the spine, with anteroposterior and oblique pictures, and sharp focussing of the tube on the presumably fractured vertebræ, were entirely negative for fracture.

As a further commentary upon the limitation of the X-rays for the diagnosis of fracture, the subsequent course of the above case is of interest. Progressive improvement occurred, the patient regaining power in both lower extremities and normal bladder control. At the Central and Neurological Hospital, to which he was transferred, the patient insisted upon being up and about, and left the institution against advice. When seen not long after, abnormal prominence of the spinous processes of the ninth, tenth, and eleventh dorsal vertebræ was noted. Without treatment this deformity will probably be progressive and the typical picture of Kuemmell's disease (*q.v.*) may ultimately develop. In consideration of the negative röntgenograms, how shall such a case then be classified, as one of Kuemmell's disease, in which fissure fractures of the vertebral bodies was the cause, or one in which traumatic softening of the bodies ("trophic" disturbances, etc., as maintained by some writers) without fracture was the etiological factor?

THE DIAGNOSTIC AND THERAPEUTIC VALUE OF LUMBAR PUNCTURE IN
SPINAL INJURIES

Unquestionably, the importance of lumbar puncture in the diagnosis of spinal injuries must be appreciated by many, yet evidences of the recognition of its true value cannot be found in the literature. Diagnostic lumbar puncture has proven of such great significance in the First Surgical Service of Bellevue Hospital that it is now employed as a routine measure in all cases of suspected or of evident spinal injury. Its value lies, of course, equally in the demonstration of the presence or of the absence of blood in the cerebrospinal fluid. This test has so aided in clarifying our views concerning the indications for operation for spinal injuries (as pointed out in the previous section), that the presence of large quantities of blood (and evidence, upon repeated punctures, of continuation of the bleeding) makes one of the exceedingly few indications for operation.

In other cases, the disclosure of blood in the spinal canal was the only evidence that vaguely suspected spinal injuries were in fact vertebral traumata with cord compression. Two such cases were seen. An impressive one was that of a man who entered the hospital in a profoundly shocked, semicomatose condition, with a history of a fall from a considerable height. When seen by me, immediately after admission, a contusion over the lower dorsal vertebræ was noted, but evidences of injury to the cord could not be elicited. Lumbar puncture disclosed the existence of active subdural bleeding. When the patient recovered from shock the signs of an incomplete injury of the lumbar cord were evident.

The groups of cases in which the presence of blood may be of unusually great value as evidence of the existence of spinal injury, with cord compression in most instances, are: (1) Suspected spinal injury in individuals suffering from acute or subacute alcoholism; (2) suspected injury in patients in coma or in confused mental states; (3) injuries suspected in cases of hysteria.

Blood in the spinal canal is not of such definite diagnostic value in cases of skull injury in which associated spinal injury is suspected, for, as is well known, blood in the cerebrospinal fluid may be the result of the cranial lesion. However, the presence of large quantities of fresh blood in the spinal canal when there are some signs of spinal injury points more to the latter as its source.

Small amounts of blood admixed with cerebrospinal fluid naturally indicate that less active hemorrhage is going on. The precaution should always be taken to collect the spinal fluid in two or three test tubes in

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order to exclude possible trauma made by the puncture needle as the source of the blood.

The lumbar puncture demonstration of the absence of an intradural hemorrhage is, as has been said, of equally great value, not only in the diagnosis and in the indications for treatment, but also for the immediate and ultimate prognosis. For reasons advanced in the previous section, the presence of clear cerebrospinal fluid eliminates one of the two indications for operation for recent spinal injury. This is well shown in the following case:

The patient was admitted to Bellevue Hospital a few hours after having been flung against her spine in a street car accident. There was some evidence of a spinal cord injury, progressing steadily, so that, at the end of thirty-six hours, there was complete loss of power and sensation in the legs, and absent reflexes. The case seemed one in which there was progressive hemorrhage about the cord and for which operation was indicated. Lumbar puncture revealed absolutely clear fluid and operation was withheld. The reflexes of the lower extremities reappeared soon after. The patient is still under observation; the present course appears one of mild injury to the cord with superadded hysteria. At any rate operation is certainly contra-indicated.

The therapeutic value of the withdrawal of subdural collections of bloody fluid is evident, particularly in those cases for which operative procedures are not indicated; yet lumbar puncture for such purposes finds no advocates. If the spinal cord manifestations of recent injuries are due to compression or irritation by fresh blood, it is clear that removal of a part or all is desirable, not only for the relief of the immediate symptoms, but also to minimize the after-effects of the hemorrhage about the cord. Conceding that only a part of the blood can be removed by lumbar puncture, even that is, I believe, better than permitting all to remain. As a further step it may prove feasible to attempt to remove, by washing, some of the remainder. Up to the present time this has been practised in only one case. The immediate results were striking, but the final outcome is unknown for the patient was removed to his home a few days after. The report:

The patient was admitted to Bellevue Hospital with a fracture of the lower dorsal spine, profound sensory loss over the lower extremities up to the level of the twelfth dorsal segment, marked paresis of both legs, increased reflexes, Babinski, etc., and retention of urine. The catheterized specimen of urine showed the

evidences of an advanced nephritis, so that operation was absolutely excluded except for the most stringent indications. Lumbar puncture revealed considerable quantities of fresh blood in the spinal canal. As much as would flow freely was withdrawn. Then repeated washings with sterile water were made until the return flow was no longer very deeply colored. Within two days the power in the legs had very greatly improved, the sensory loss was of a much slighter degree, and the patient voided voluntarily. It is of course impossible to say how much improvement might have occurred without this procedure, but the result is certainly suggestive.

THE SURGICAL TREATMENT OF POST-TRAUMATIC DEFORMITY OF THE SPINE (KUEMMELL'S DISEASE) WITH SPINAL CORD SYMPTOMS

This condition, aptly termed "Déformation Vertébrales Traumatiques Tardives," by French writers, is far from rare, yet it is barely mentioned in American literature. More than 100 cases have been reported since Kuemmell, in 1891, first made the affection generally known. Its etiology, symptomatology, etc., will be referred to very briefly here (a detailed account being reserved for another place), for I wish to dwell upon the question of surgical treatment.

Post-traumatic deformity of the spine may develop after injuries ranging from mild to very severe, and from direct or transmitted violence. Three stages in the symptomatology can usually be recognized. The primary one is that of the immediate manifestations of the injury—more or less localized tenderness and pain over the spine, occasionally motor and sensory disturbances referable to slight and transient injury of the spinal cord or nerve roots, etc.—lasting for a very varying length of time, and of varying degrees of severity. The second phase, the "free interval," is characteristic. The primary symptoms and physical signs recede or, in some cases, disappear. The patient apparently is well, returning to his occupation in many instances. Occasionally the free interval is of very brief duration, or hardly can be said to exist; in most instances, however, it is quite definite, and of weeks' to months' duration. The third stage is the development of kyphosis, sometimes angular but usually more diffuse, with the return of some or all of the symptoms of the first stage or the appearance of new manifestations. In some cases the progressively increasing deformity of the vertebral column is the sole manifestation of the third stage.

The pathogenesis of Kuemmell's disease has not as yet been definitely

established, chiefly because necropsies are not obtained during its evolution. According to one group of observers the lesion is a fracture of the vertebral body which, when not distinguishable radiographically, is presumed to be in the nature of fine linear fissures. The theory of a rarefying osteitis without fracture has been advanced by others. The remarks made in the previous section have a definite bearing upon this question.

The treatment of Kuemmell's disease has, up to the present time, consisted in the application of plaster jackets and, later, lighter corsets, for the correction of the deformity, the prevention of its further development, or for the relief of pain. In many instances this treatment has been effective, in others it has failed. Although it often involves prolonged periods of incapacitation, immobilization appears to be the correct treatment for the majority of cases. It is not at all evident, however, that the method is equally logical if the late symptoms are referable in part or entirely to lesions of the spinal cord or cauda equina. In fact, immobilization relieved some but did not cure any of the reported cases of this type. One cannot understand, therefore, why operative treatment was not advised or practised here, for it is universally known that lesions such as adhesions about or angulation of the cord, nerve root irritation, etc., can be relieved by operation. I wish to advocate operation for the group of cases in question, basing my opinion upon these considerations and upon the results I have obtained by laminectomy in the following cases. In one there was prompt and lasting relief of pain and return of normal motor power following operation for Kuemmell's disease affecting the cauda equina. In the second, the relief from pain was equally prompt and the sensory improvement has been steadily progressive. The third case has shown no improvement, presumably due to the existence of syphilis and to the prolonged duration of the deformity and cord compression. The second case is particularly interesting as a demonstration of the presence of the cord lesion several vertebræ removed from the situation of the deformity. The first is the only one in which a fracture was found in the X-ray picture.

CASE I.—A drug addict, twenty-five years old, was admitted to Bellevue Hospital with the history that, four months before, crazed by the withdrawal of heroin, he leaped from a fifth-story window, landing on his feet. He was unable to walk and was put to bed. Fractures of the os calcis and external malleolus were found, and there was tenderness and pain over the midlumbar vertebræ. At first there was complete loss of power in the lower

extremities. This cleared up rapidly, so that only weakness in the right leg remained after one month. Pain in the back and right leg was very severe in the beginning, clearing up almost completely within a few weeks. A deformity of the spine was not noticed. Six weeks after the injury the patient was able to walk well except for some difficulty in supporting his weight on the right leg (due to the injuries at the ankle?), and was almost completely free from pain. This relatively clear interval was of about three weeks' duration. At the end of that time pain in the lower back and pain and weakness of the right leg (to a much lesser degree of the left) gradually reappeared. Slight prominence of the spinous process of the third lumbar vertebra was noted. A plaster jacket was applied. Despite this, pain and weakness continued, became progressively worse for about two weeks, and then remained stationary. During a period of several weeks' close observation there was no evidence of improvement in pain or in power of the right leg. Pain was constant, sometimes dull and aching, occasionally sharp and shooting in character.

Physical Examination.—There was moderate kyphosis of the entire lumbar spine; the spinous process of the third lumbar vertebra was somewhat more prominent than normal and slightly deflected to the right. X-ray examination showed a finely comminuted fracture and moderate narrowing of the body of the third lumbar vertebra, with slight lateral rotation. All motions of the lumbar spine were restricted. The usual and the X-ray examination showed good healing of the fractures about the right ankle. The power of all the musculature of the right leg, except the quadriceps, was greatly reduced; the range of voluntary motion at the knee was fair, at the ankle slight, almost completely absent in the toes. There was some diminution in power, but fair range of motion, in the left lower extremity. Both feet, especially the right, were cold, and a zone of abnormal perspiration was present over the right foot and calf. Sensory loss was complete on the right side, over the foot and outer aspect of the calf (fourth and fifth lumbar and part of first sacral roots); on the left side over a much smaller area (chiefly fifth lumbar root). The knee and ankle jerks were greatly diminished on the right, absent on the left side.

A typical laminectomy was performed in August, 1916. The dura was found encroached upon by the laminæ of the third lumbar vertebra; upon their removal the dural sac filled out. The subflaval ligament was much thickened. The epidural fat was not adherent except in a small patch on the right side at the third lumbar lamina. Opposite this point two roots of the cauda equina were closely held to the inner surface of the dura by thin

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adhesions. The latter were divided; the roots, together with the cauda as a whole, receded to an approximately normal position. The surfaces of the roots of the cauda were moderately congested but there were no adhesions between them. The wound was closed in layers in the usual manner.

The prompt post-operative disappearance of pain and the rapid improvement in motor power, sensations and reflexes, with return to the normal in three weeks, are detailed elsewhere. The result was entirely satisfactory.

CASE II.—A man, thirty-nine years old, was admitted to Bellevue Hospital with the history that, eight months before, he fell with an elevator, striking his back sharply against the floor of the car. He was stunned, but did not lose consciousness. After remaining in bed for ten days, suffering severe pain in the upper dorsal spine, the patient could get about. Pain and sensitiveness gradually abated (so that he was able to return to his work), but did not disappear. Five weeks after the injury the patient noted a peculiar clumsiness of his legs, and he stumbled and fell while ascending a flight of stairs. Thereafter, the pain became much more severe, and complete incapacitation from work soon followed. Pain between the scapulæ, radiating down the arms, and occasional shooting pains in the legs have persisted up to the present. There have been frequent painful erections, occasionally attended by emissions. A deformity of the spine has not been noticed.

Upon physical examination it was evident that the patient was suffering considerable pain, exaggerated by the slightest efforts at moving the upper dorsal spine. The latter presented a very slight kyphosis with definitely abnormal though slight prominence and some lateral deviation of the spine of the fourth dorsal vertebra. The latter and the spines of the three vertebræ above it were tender upon pressure or percussion. The motor power in the upper and lower extremities was good except for marked weakness of the extensors of the left foot. The knee and ankle jerks were diminished. The evidences of a lesion of the lowest cervical or first dorsal segment of the cord were contracted right pupil with narrowing of the palpebral aperture and enophthalmos, and marked diminution in all sensations from a short distance below the clavicles downward, as well as along the inner aspects of both upper extremities. The diminution was greater over the right half of the body. It deepened to complete loss in scattered areas on the lower extremities. Röntgen examination showed the deviation of the fourth dorsal vertebra, but no evidence of fracture. Lumbar puncture revealed no abnormalities.

Operation (January, 1917).—The spines and laminæ of the sixth and seventh cervical and first dorsal vertebræ were removed in the usual way. The exposed dura was of whitish color and moderately thickened. There were several fine adhesions between the pia arachnoid and the inner surface of the dura on the right side opposite the situation of the sixth cervical lamina; they were divided with scissors. The exposed cord was somewhat smaller than the normal for this region, and was overspread by several engorged, rather tortuous vessels. The wound was closed in layers and a posterior wooden splint incorporated in the dressings.

There was prompt disappearance of pain after operation, much slower improvement in the area of disturbed sensation. The pain has never returned. At the present time, three months after operation, the patient is subjectively entirely well, and able to do heavy work. There is evidence of progressive sensory improvement, seen in the recession of the upper level of sensory disturbances and in the much slighter degree of diminution of sensations.

CASE III.—Female, aged fifty, had been in the Central and Neurological Hospital for six months without any change in symptoms. Four years before she slipped in the street, falling on her buttocks. She was unable to stand and suffered severe pain in the lower spine. The loss of power in the legs was of several days' duration; with rest in bed there was gradual improvement so that, at the end of five weeks, the patient was able to be up and about. Backache remained constant, however. About six months after the fall, prominence of the lower dorsal spine was first noticed. This increased progressively for several weeks and then became stationary. Not long after that pains in and weakness of the lower extremities began to develop, soon followed by frequency and difficult control of urination. One day, while walking about, the patient slipped and fell, and found she was unable to get up. Since that time (1913), there has been complete loss of power and marked stiffness in the lower extremities, complete incontinence of urine, and obstinate constipation.

Physical Examination.—There was a rather sharply angular gibbus involving the ninth, tenth, eleventh, and twelfth dorsal vertebræ, and a rounded kyphosis above and below it. The latter could be in part overcome by hyperextension, but the gibbus remains unaffected. Several X-ray pictures were unsatisfactory in the delineation of the vertebral bodies of this very obese patient. There was no voluntary power in the lower extremities; they were extremely spastic and presented the abnormal reflexes that

go with pyramidal tract involvement. Sensory loss was complete over both lower extremities, extending upwards to the level of the twelfth dorsal segment.

The Wassermann test of the lumbar puncture fluid was positive. In view of this and of the long-standing period of pressure upon the cord it was evident that operation could not offer the likelihood of great relief. However, prolonged antisyphilitic treatment had been of no avail, and, with the diagnosis of a Kuemmell's spine with compression of the cord, engrafted upon a (probably) luetic disease of the vertebræ, there was evidently no outlook for improvement by such treatment. Operation was therefore advised.

Operation (February, 1916).—The gibbus was exposed. The musculature on either side was pale and atrophic. The spines and laminæ of the eighth to twelfth dorsal vertebræ were removed; the ninth, tenth, and eleventh were very superficial, the eighth to twelfth unusually deep and obliquely placed. After removal of the adherent epidural fat, the exposed dural sac was found to be bent sharply backwards by the bodies of the affected vertebræ. The thickened, scar-like, tense dura was incised; the lips of the incision immediately separated and the cord presented in the gap. There were a number of fine adhesions between the cord and inner surface of dura that could be divided without bleeding. The cord was then found to be flattened to a surprisingly slight extent. Fascia was transplanted into the dural gap, as described in a previous section; the remainder of the wound was closed in layers. After operation there was a partial regain of bladder control for several months. The patient has stated frequently that her legs are less stiff than before operation, but this cannot be substantiated by physical examination. The dull, aching pain in the back has been permanently relieved and the patient says she is able to sit up better and more comfortably in her chair. Antisyphilitic treatment has been continued since the operation. The result of the operation has manifestly been practically no objective and some subjective improvement.

INDICATIONS FOR AND RESULTS OF OPERATION IN SOME POST-TRAUMATIC
LESIONS OF THE SPINAL CORD OTHER THAN KUEMMELL'S DISEASE

The late effects of spinal injuries and the possibilities for their relief by operation have been emphasized recently by Elsberg. He described various lesions that were found at operation: Narrowing of the spinal canal by callus, pressure upon the cord by displaced fragments of bone or by one or more vertebral bodies, fracture of a transverse process producing root pain, rupture of the ligamenta subflava,

and fibrous bands constricting the cord. In the following small group of cases I wish to describe briefly some additional types of lesions the late results of injury. In presenting them the chief purpose in mind was to stress the following views:

A fair proportion of the patients that present themselves for operative relief from the lesions in question are not seriously incapacitated, do not suffer very greatly in many instances, and can live in some comfort for an indefinite number of years without operation. Manifestly there should be no mortality risk for such patients from the operation of laminectomy. Therefore, cases in which there is marked organic disease of the heart, kidneys, etc., and those in poor general physical condition, should be excluded except when the suffering from the spinal lesion is great, incapacity extreme, and when, in addition, the outlook for relief appears very bright. If the symptoms of cord injury have been of very prolonged duration, it may in general be said, I believe, that the chances for much improvement are slight (as in the two cases of post-traumatic sclerosis of the cord reported below), and it is particularly for this group of cases that the indications for operation must be most sharply drawn. The steps of the operation should be so carefully conducted and the post-operative care should be so scrupulous that the minimal possibility of making conditions worse by the laminectomy will exist. Finally, one can say, as a corollary to the foregoing remarks, that, in contrast to those desperate cases in which heroic or new operative measures have a proper place, the cases in question should not be subjected to untried procedures unless based upon logical and well demonstrated experimental evidence.

CASE I.—*Cystic subdural collection of fluid following injury to the dorsal spine. Laminectomy. Marked improvement.*[1] Male, fifty-two years old, admitted to the hospital in April, 1915, complained of pain in the back and the lower extremities, paraplegia, and incontinence of urine. Fifteen years before, he fell on his back from a height of some ten feet. He was in bed for almost a year, with both legs paralyzed, and rectal and bladder incontinence. Gradual improvement then began until the patient was finally able to get about a little with crutches. About three months before admission, marked weakness in both legs developed, more pronounced on the right side. For the first time pain, situated in

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[1] This and the succeeding two cases were studied in conjunction with Dr. Climenko, at the Central and Neurological Hospital, and an earlier and fuller report on them has been made (*The Hospital Bulletin of the Department of Public Charities,* January, 1917).

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the back and the legs, appeared, and became progressively worse. The patient noticed gradually increasing "loss of feeling" and coldness in the lower extremities, especially over the anterior surfaces. Two months before admission difficulties in the urination began. By the time the patient came into the hospital there was almost complete loss of bladder control and of power in the legs.

The general condition was fairly good. When his body was supported on crutches the patient could drag his legs along the floor with great difficulty. There was slight tenderness of the spines of the sixth to ninth dorsal vertebræ, but no visible deformity. X-ray examination and Wassermann tests were negative. The lower extremities were exceedingly spastic; there was almost total loss of voluntary power in them. The evidences of pyramidal tract involvement were found in the bilateral patellar and ankle clonus, Babinski phenomenon, etc. Abdominal reflexes could not be elicited. Sensory disturbances began at the level of the ninth dorsal segment, gradually deepening until sensory loss was complete below the inguinal folds.

At operation in July, 1915, the spines and laminæ of the fifth, sixth, and seventh dorsal vertebræ were removed. No abnormalities in the bone were noted. The dura was of normal appearance except in a small area about the middle of the exposed portion, where it was more opaque. It was incised above and below this area, cerebrospinal fluid escaping in normal quantities. Stretching from the cord to the thickened part of the dura were thin bloodless adhesions. These were separated, releasing about two drachms of clear fluid indistinguishable from cerebrospinal fluid. The cord was slightly flattened and injected at the site of the localized collection of fluid, normal elsewhere. The dura was sutured, and the wound closed in layers.

Pains in the back and lower extremities disappeared shortly after operation and have not returned. There was steady improvement in the paraplegia and the sensory disturbances. Nine months after operation, the patient was able to walk several blocks with the aid of crutch or cane, bearing little weight on them. There was fair range of motion and power in both limbs at the hips, knees, and ankles (the left leg showing the greater improvement); their nutrition was also greatly improved. Spasticity was still great, however, and all the evidences of pyramidal tract involvement persisted. The abdominal reflexes had returned. Pain sensation was practically normal throughout. Tactile sense was disturbed only on the dorsum of the right foot. The temperature sense was impaired along the outer aspect of the right calf. Postural and deep muscle senses approximated the

normal. The patient was able to return to a rather laborious occupation (automobile painter) eleven months after operation.

At the present time (one and one-half years after operation) there is still moderate spasticity of the legs, but excellent power and range of motion. Ankle clonus and Babinski persist. The abdominal reflexes are lively. Sensations are practically normal throughout. The patient remains free from pain.

CASE II.—*Adhesions and compression of the cauda equina following injury. Laminectomy. Improvement.* Female, thirty years old, married. Admitted to the hospital in September, 1913, complaining of weakness of the legs, more marked on the left side, severe pain in the back and in the right leg, and partial loss of bowel control. Eight years before the patient fell down a flight of stairs, striking her back. She remained in bed for several weeks, suffering severe pain in the back and legs; these symptoms cleared up in the course of several months and she felt quite well again, able to attend to her work. Four years before admission, the patient noticed that her legs, the left especially, were becoming weaker. Pain in them and in the back developed about the same time. These symptoms were rapidly progressive; within one month of their appearance the patient was unable to walk or even to stand. The left leg became quite " numb and dead," but free from pain. Difficulty in urination developed; the patient was removed to a hospital, where catheterization was required for several weeks. Voluntary control has been fairly good since that time. Obstinate constipation made its appearance, with very slight control when cathartics were administered. After these symptoms had persisted for about a half year, the right leg began to improve, so that the patient was finally able to get around a little with a brace supporting the left hip. However, the pains in the back and in the right leg became steadily worse, so that, during her stay in the hospital, the administration of morphine was frequently required, a grain or more ultimately being given every day or two.

The patient was in good general condition. Upon frequent occasions it was evident that she was suffering severe pain. With the hip brace she was able to walk short distances. There were no voluntary motions in the left lower extremity except some abduction at the hip. On the right side the motions were of fair range but of little power in the hip and knee, slight in the ankle, absent in the toes. Both extremities were very cold. There was considerable atrophy of both glutei (left greater than the right) and of the musculature of the extremities (left greater than the right), especially of the left quadriceps. The knee and ankle jerks were absent on both sides. There was profound loss of postural

and muscle sense on the right side, very slight on the left. The sensory loss was complete on the right side up to the knee and over the posterior aspect of the thigh, incomplete over the anterior surface of the thigh. A hypalgesic and hypæsthetic zone surrounded the body at the level of the iliac crests; this was the only sensory change found on the left side. There was a vaguely defined hyperalgesic zone referable to the tenth to twelfth dorsal segments. There was some tenderness of the first lumbar spine, but no limitation in mobility and no deformity. X-ray examination and lumbar puncture were negative. The abdomen was relaxed, the upper right reflex was the only one that could be elicited.

Operation (December, 1915).—The twelfth dorsal, first and second lumbar spines and laminæ were removed. The first lumbar was at a slightly deeper level than the others and rotated somewhat on its long axis, so that the hiatus often encountered between the twelfth dorsal and first lumbar spines was exaggerated. After removal of the twelfth dorsal and exposure of the dura, it was evident that the body of the first lumbar encroached upon and compressed the dura. The density of the laminæ of the first lumbar was greater than that of the other vertebræ. The exposed dura appeared normal; its incision was followed by the escape of the usual quantities of cerebrospinal fluid. The inner surface of the dura was thickened opposite the abnormal lumbar vertebra; from this diseased area firm short adhesions extended to the adjacent cauda equina, sharply angulating and obscuring the roots. After division of the adhesions, the cauda equina, as a whole, receded to its normal position. The roots were then carefully separated from one another, this being carried only far enough to distinguish the individual trunks. The dura was sutured, and the remainder of the wound closed in layers.

The patient was entirely free from pain soon after operation; and there has been no recurrence of pain at any time. A pressure ulcer developed over the right great trochanter, healing slowly with appropriate treatment. There has been steady improvement in the sensory, much less in the motor, condition.

The following notes were made one year after operation: The patient can get around better than before operation, with the aid of her hip brace. She notices more power in the left hip and in all the motions of the left leg. There is complete control of bowel movements, and cathartics are very rarely required. She is entirely free from pain. The range of movements and the power in the right lower extremity are moderately improved. Postural sense is good at the right hip, defective at the knee, good at the ankle except in internal rotation, absent in the toes. On the left side abduction at the hip is excellent, adduction is poor,

flexion is almost *nil;* there is some flexion at the knee, accompanied by abduction with each attempt; occasionally there is a voluntary movement of the big toe. The loss of sensation on the left side is reduced to a small patch of hypæsthesia and hypalgesia over the buttock. On the right side the area of sensory loss has shrunken and is less sharply defined; it is complete only below the knee. None of the reflexes in the lower extremities have returned, with one peculiar exception: Upon attempting to elicit the left ankle jerk there sometimes follows a delayed adduction and internal rotation of the leg.

CASE III.—*Post-traumatic sclerosis of the cervical cord. Laminectomy. Slight improvement.* Male, thirty-nine years old. Admitted to the hospital in July, 1913. In 1908, while working in an excavation, a heavy boulder struck the back of his head and neck a glancing blow. He did not become unconscious. There was some pain in the injured region for several weeks. Some time after the injury (perhaps four months) the patient noticed weakness in the shoulders, slowly extending to the arms and legs. This became progressively worse, so that he was unable to do any heavy work three years before admission. At the time of entrance into the hospital, the chief complaints were: Great difficulty and unsteadiness in walking, often falling when out of reach of support. A " rushing " gait (by which the patient means uncontrollable forward propulsion). Difficulty in the use of his arms, more marked on the left side. . . . During his stay in the hospital the patient's condition became steadily worse for about a year and a half, since which time no further changes have been noticed.

The general condition of the patient was good. His head was arched far forward, the dorsal spine kyphotic. In standing, his feet were kept widely separated, the body weight borne on the balls of the toes. The gait consisted of a number of uncertain, extremely spastic strides, followed by rapid, progressively increasing forward propulsion, until the patient brought up at some obstacle. There was some percussion tenderness of the very prominent seventh cervical vertebra; the other cervical spines could not be palpated, owing to the thick musculature and the arching of the neck. The upper extremities showed some atrophy of the musculature, especially in the shoulder-girdles and the upper arms. There was little power and marked spasticity in both, more marked on the left side. No reflexes were obtained. The lower extremities were far more spastic than the upper, but were not atrophic, and the reduction in power was not so great. The knee-jerks were exaggerated, the ankle-jerks diminished, a Babinski phenomenon was occasionally elicited on both sides. All

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the abdominal reflexes were present. Loss of sensation was complete over the lower extremities, and almost complete up to the level of the seventh cervical segment. Above this there was a wide zone of hyperæsthesia and hyperalgesia. Wassermann tests of the blood and spinal fluid and X-ray examination were negative. Prolonged antisyphilitic treatment was without effect.

Operation (July, 1915).—The fourth, fifth, sixth, and seventh cervical spines and laminæ were removed. They were of normal consistency and contour. The exposed dura looked normal; its incision was followed by the escape of the usual quantities of cerebrospinal fluid. The exposed cord was smaller than normal, flat, pale, and firm. Below, it was surrounded by thin adhesions extending from it to the under surface of the dura. These were separated. Near the upper angle of the wound the cord felt softer; it was aspirated here with negative result. A probe, passed in various directions, met no obstructions. The wound was closed in the usual manner.

Improvement in the gait began about six weeks after operation, was very slowly progressive for several months, and then ceased. The patient can now walk fair distances either unaided or with the use of a cane. The forward propulsion has disappeared. The power in the arms has improved slightly. No diminution in the spasticity of the lower extremities can be objectively determined, yet the patient has better control over their movements. One year after operation, the zone of hyperalgesia above the seventh cervical segment persisted, but sensation has almost completely returned below this. Movements of the head are much freer than before operation. One and one-half years after operation the motor condition is about the same, but sensations are normal throughout.

Case IV.—*Post-traumatic sclerosis of the cervical cord. Laminectomy. Very slight improvement.* The operation was performed on this patient so recently (three months ago) that the very slight changes noted up to the present time may possibly be no index of what will happen in the future. The operative findings are so similar to those of the previous case, however, that much additional improvement is not looked for. A very brief report will therefore be made.

The patient, a fireman, two years ago fell a distance of 40 feet, landing on his back. He was in bed for several weeks thereafter, suffering pain in the back and legs. A few months later stiffness and weakness of the right arm and leg developed; gradually the left arm and leg became affected. There was no pain at any time, and no involvement of the bladder or rectum. At admission to Bellevue Hospital the patient could walk short

distances with the aid of a cane. All four extremities were weak and exceeding spastic, with corresponding abnormal reflexes. Abdominal reflexes were obtained; the eye grounds were negative. Spinal fluid and blood tests were negative. Sensations were normal except for a zone of well defined although slight increase of all sensations in a thin band about the upper chest. X-ray examinations showed evidences of a diffuse osteoarthritis, most marked in the lower cervical region, and of old fracture in the lumbar region.

At operation, in the lower cervical region, the ligamenta subflava were thickened; there were some adhesions about the cord. The latter was smaller than normal, and presented a firm nodular thickening opposite the sixth cervical vertebra. Since operation, the zone of increased sensations has disappeared, the spasticity and weakness in the extremities have improved slightly so that the patient can get about somewhat better than before. The abnormal reflexes are as before operation, but not of so extreme a grade.

PNEUMOCOCCUS EPIDURAL ABSCESS SECONDARY TO CHRONIC LOCALIZED OSTEOMYELITIS

The clinical picture of acute osteomyelitis of the spine is well known. At operations or at necropsies one or more localized collections of pus have been found in some cases. As the result of a diffuse infection of the bone, in other instances, purulent meningitis has been the final outcome. In most cases the ordinary acute osteomyelitis of the spine does not produce spinal cord symptoms; in exceptional ones such symptoms are referable to a widespread involvement of the spinal meninges. Tuberculosis, syphilis, and actinomycosis are the causes of the great majority of cases of chronic osteomyelitis of the vertebræ; any of them may result in the formation of an epidural abscess. In the few cases of chronic staphylo- or streptococcus abscess of the spine symptoms referable to the cord have not been described. The following case [2] is therefore reported not because it is thought to be a unique or bizarre condition, but as a clinical picture of a late effect of a bacterial infection.

Male, thirty-one years old, was admitted to the Har Moriah Hospital in December, 1915, suffering from total paraplegia and bladder and rectal incontinence. Four years before, a prolonged attack of pneumonia was followed in one month by a (pneumococcus?) osteomyelitis of the tibia, for which an extensive osteotomy

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[2] Studied in conjunction with Dr. Climenko.

was performed. Thereafter the patient was entirely well and did heavy work until two weeks before admission, when weakness in the legs and inability to walk developed rather suddenly and the patient found that he was unable to urinate. Severe constricting pain about the chest and darting paints in both legs developed within 24 hours. The next day red and tender spots appeared in a narrow band about the upper chest. The patient became completely bed-ridden soon after. Regular catheterization was required. The bowel movements became very constipated, and finally impossible without enemata. Adhesive straps were applied over the skin lesions about the chest.

Examined upon admission the patient was found to be suffering considerable pain in the back and upper chest, greatly exaggerated upon ineffectual efforts to turn in bed. There were pressure ulcers over the sacrum and back. In a narrow strip about the upper chest were healing skin lesions referable to the second dorsal segment. The upper dorsal spine was rigidly held and the patient was unable to flex his head, apparently because of this muscular spasm. The fifth to ninth dorsal spinous processes were tender. Except for a small patch of preserved sensation to the left of the anus, all sensations were lost in both legs and as high as the level of the ninth dorsal segment to the left, the tenth dorsal segment on the right side. Both legs were absolutely immobile, and very spastic. The knee and ankle jerks were exaggerated, more so on the left side, and a left ankle clonus was obtained. The Babinski and other phenomena referable to pyramidal tract involvement were present. Abdominal and cremasteric reflexes were not obtained.

Two days after admission the level of lost sensations had extended upwards to the sixth and seventh dorsal segments. Within the next forty-eight hours the level of sensory loss had reached the third dorsal segment, ankle clonus (which had also developed on the right side) became very easily exhaustible. The latter, particularly, suggesting rapid progress of the lesion, led to the decision for prompt operation.

At no time during the period of observation was there any rise in temperature. Regular catheterization was necessary; bowels moved only with enemata. Blood counts were normal. Wassermann tests of the cerebrospinal fluid and blood were negative. The fluid withdrawn by lumbar puncture was clear, under normal pressure, and revealed no abnormalities other than a moderate increase in cells. Unusually clear X-ray pictures of the dorsal spine were absolutely negative.

In the diagnosis some interesting questions came up but these cannot be considered in this place. The existence of an epidural abscess was not suspected.

Operation was performed five days after admission to the hospital. The spines and laminæ of the first, second, third, and fourth dorsal vertebræ were removed. The laminæ of the second and third were somewhat thickened, and of ivory-like consistency. When those of the second dorsal were removed there escaped under considerable pressure about a half ounce of thick, greenish-yellow pus. The surface of the exposed dura was very deeply congested, evidently much thickened, and plastered over here and there by shaggy granulation tissue. The epidural fat was firmly adherent in several places and deeply injected throughout. A drain was inserted to the dura, and the muscles, aponeurosis, and skin closed in layers about it.

Examination of the pus yielded pneumococcus in pure culture. Microscopic examination of fragments of the laminæ of the second dorsal vertebra showed that it was the seat of a chronic osteomyelitis; the epidural fat showed acute inflammation (Surgical Laboratory, Columbia College of Physicians and Surgeons).

Improvement set in rapidly immediately after operation. Pain disappeared. Within two days tactile and temperature sensations began to return in patches in the zone in which they had been completely lost, and very slight voluntary movements in the toes and ankles could be executed. Bladder control began to return in one week. The sensory improvement continued very much more rapidly than the motor. At the time of discharge from the hospital, five weeks after operation, sensations approximated the normal, the patient was entirely free from pain, bladder and rectal control were normal, and there was fair voluntary power in the lower extremities. The latter, however, remained very spastic, with all the evidences of pyramidal tract involvement, so that only very slow improvement can be expected. It is very possible that posterior root section for the relief of spasticity, or the operative treatment of a residual lesion about the cord, may be indicated.

THE SIGNIFICANCE OF THE DISAPPEARANCE OF REFLEXES AND OF RETENTION OF URINE AFTER LAMINECTOMY

Attention was first called by Elsberg to the changes in the reflexes after spinal operations. He found that the knee jerks were often lost for from twelve hours to several days after operation and that the ankle jerks were often considerably diminished for several days. This loss or depression of the reflexes was noted even in cases in which greatly exaggerated reflexes existed before operation. Retention of urine for several days to several weeks has been commonly observed

after laminectomy even when there have been no preoperative disturbances in vesical function. The alteration in the reflexes has been presumed to be the result of changes in intradural pressure from the escape of large quantities of cerebrospinal fluid and the entrance of air into the subdural space at operation, for loss of the reflexes was never observed when the dura was left unopened. It is inferred that the post-operative retention of urine is ascribed to the same causes.

It is my belief that transient post-operative disappearance of reflexes and retention of urine are the results of mild injuries to the spinal cord at operation, from the necessary operative manipulations involved in the removal of tumors and the treatment of other lesions. This belief is based upon the following observations: In eight spinal cases operated upon by me at various levels only minimal manipulations of the cord were required for the conditions that were encountered. Some of these patients had exaggerated, others had diminished, ankle and knee jerks before operation; two had slight, the remainder had no vesical disturbances before operation. Examination of the reflexes was made twice daily for the first two or three days after operation. In none of the cases did the reflexes disappear, and in none was post-operative catheterization required.

The question is of practical as well as theoretical interest. For if, on the one hand, it is clearly recognized that lost reflexes and post-operative catheterization may be the justifiable sequelæ of removal of lesions in intimate association with the cord or cauda equina, of necessarily extensive exploration of the cord for small tumors, etc., it should also be recognized that these changes are not to be expected from the operation of laminectomy and incision of the dura in itself. Even a short period of post-operative catheterization is not a negligible matter; the possibility of bladder infection in patients suffering from spinal cord lesions is too well known to be dilated upon. Similarly, if temporarily lost reflexes are accepted as due to trauma to the cord or cauda equina, increasing efforts will be made, by care in avoiding a single unnecessary manipulation of these structures during operation, to reduce the number of instances in which the disappearance of reflexes and post-operative retention will be observed.

THE RETURN OF REFLEXES AND OF SENSATION AFTER CAUDA EQUINA INJURY

Some observers maintain that the loss of reflexes and of sensation, with corresponding loss of muscle tone and power, are permanent after injury to the cauda equina, and that, therefore, the sole indication for

operation for such injuries is the relief of pain. The following case is presented as evidence that this view is not correct (for relatively recent cauda injuries at any rate) because it demonstrates the prompt return of reflexes, sensation, and muscle power, after an injury which did not sever the caudal roots.

The details of the history and operation are given in another place. The patient came under observation in Bellevue Hospital four months after an injury that resulted in prominence of the spine of the third lumbar vertebra. He complained of severe pain in the back and in the right leg from the knee down, less in the left leg. There was marked weakness of the muscles of the right leg, except the quadriceps, and some reduction in power at the ankle joint and toes of the left. The left knee and ankle jerks were absent, the right were considerably reduced. All sensations were lost on the right side over the dorsum of the foot and toes, and over part of the calf; that is, in an area corresponding chiefly to the fourth and fifth lumbar roots. There was a much more restricted zone of sensory loss on the left side, being chiefly limited to the dorsum of the foot.

The operative findings consisted essentially in compression of the dura and adhesions between some of the roots of the cauda and the inner surface of the dura. The compression was relieved and the adhesions separated.

Immediately after operation pain in the lower extremities disappeared, and did not return. Increase in muscular power in the legs began within forty-eight hours of the operation; at the end of eight days the power in flexion and extension at the knees and ankles was about the same on both sides and approximated the normal. Sensation likewise began to improve very soon after operation. At the end of eight days the anæsthetic zones were moderately hyperalgesic and hyperæsthetic. A slight left knee jerk was obtained for the first time three days after operation, the left ankle jerk appeared two days later; both reflexes steadily increased.

At the time of discharge from the hospital, three weeks after operation, there was excellent tone of the musculature and normal power of both lower extremities, and free range of motion at the knees, ankles, and toes. The knee and ankle jerks were normal on both sides. No abnormalities in sensation remained.

THE SIGNIFICANCE OF " BED SORES "

There must be a generally prevalent view that the decubitus or pressure ulcer (commonly termed " bed sore ") is an essential part

of the picture of certain types of progressive spinal cord disease, otherwise one would not read or hear so often of lesions of the spinal cord "progressing to complete paraplegia and, finally, bed sores, complete incontinence of the sphincters, and death." That there is a pronounced tendency to the development of this complication in spinal cord affections, particularly in rapidly progressing myelitis, cannot be denied. But it is a far cry from this to, practically, the inclusion of bed sores as an integral part of the disease. It is true that they most often develop in those spinal cord conditions in which the outlook is absolutely hopeless. Perhaps this is the reason for the lack of application of the necessary measures for their prevention, and for a certain passivity upon their appearance. The practical importance of the prevention of pressure ulcers, as well as the necessity for careful treatment should they unfortunately develop, is evident when it is realized that sepsis from such lesions may be and not infrequently is the cause of death in those who otherwise might have become well, and that patients suffering from apparently hopeless lesions of the cord have been known to recover.

There is ample opportunity to investigate the question of the relation between bed sores and advanced cord lesions in the Central and Neurological Hospital. In every instance a decubitus could be directly ascribable, not to the disease from which the patient was suffering, but to the care given the patient. It is unnecessary to recapitulate the many precautions necessary for the avoidance of bed sores. It will suffice to say that the least let up in painstaking nursing and supervision may result in their appearance. A single impressive illustration may be mentioned: A bed-ridden patient at Bellevue Hospital, suffering from a fracture of the cervical spine, was operated upon by me and under observation thereafter for many weeks. During that period, with the adequate care given him, there was no trace of any decubitus. He was transferred to the Central and Neurological Hospital; in transit he spent several hours lying in one position on an unpadded stretcher carriage. Next day bed sores over the sacrum, back, both heels, and elbows had appeared and, despite careful protection, had begun to spread.

Perhaps the best evidence that decubitus ulcers are not primarily due to the spinal disease is seen in the fact that, unless very extensive, they frequently heal with proper nursing and treatment. There have been cases admitted, with numerous bed sores, to our division at Bellevue Hospital, in which these lesions have cleared up with adequate

care and despite the fact that the spinal affections from which the patients were suffering were irremediable.

Although many advances have been made in spinal surgery in recent years, the whole subject is as yet in an early stage of development. Many of its aspects are obscure and their solution by surgical treatment inadequate. The detached and rather fragmentary observations that have been made represent personal impressions held at the present time upon a few of these topics. They are presented chiefly with the idea that others will likewise state their views upon and experiences in such unsettled questions in spinal surgery, in the hope that some of these questions will be thereby clarified.

THE TREATMENT OF WOUND INFECTION

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IN 1915 I invited attention in the *Lancet* to the results which I have obtained by treating desperate cases of infected railway wounds by four hourly irrigation with hot peroxide solution (℥ii to litre) followed instantly by hot carbolic lotion (℥ss to litre), and the application of hot perchloride of mercury fomentations (wrung dry).

A recent interesting summary by Capt. d'Este Emery, of his laboratory experiments with different antiseptics, encourages me to again ask surgeons in large hospitals to give the above a trial alongside similar cases treated by other methods.

It is, to say the least, an extraordinary coincidence that after decades of synthetic experiments, the first antiseptic (carbolic acid) used by our great pioneer, should retain its place, *facile princeps,* in the gamut of chemical disinfectants. Personally, I have given most antiseptics a trial during a continuous hospital experience of twenty-five years, and I confess that, for financial reasons, I was disappointed last year in the hope that eusol would prove equally efficacious, as the "peroxide carbolic" combination is a serious item of expenditure, when used on a large scale in a general hospital. I may mention the eusol was employed exactly as prescribed, and applied, by its Edinburgh advocates in severe cases, like compound fractures, in which streptococci and gas bacilli were in abundance, but it became very soon obvious, when treating similar cases alongside each other by the two methods, that "peroxide carbolic" was far superior and, moreover, it was frequently noted that, in cases treated with eusol, in which failure was very evident, a remarkable change occurred within three days after the "peroxide carbolic" was substituted, the granulations promptly assumed a healthy bright red appearance, the quantity of pus diminished, stench disappeared, with marked diminution in general toxic symptoms. Both were also tested side by side in cases of pelvic infection (*Bacillus coli*), and the results were identical to those obtained in bemudded mangled wounds of limbs.

Since above was written, I had the opportunity of asking the Sister in charge of the department in which most of our grave septic cases are treated, her opinion as to the respective value of "peroxide car-

bolic " and eusol. She replied, " I like the ' peroxide carbolic ' best, it does not bring out eczema all round the wounds like eusol does," " the wounds have a better color with the carbolic."

Perhaps this independent testimony, of a most experienced nurse on whom the real brunt of the work falls, may be of interest.

Some ten years ago I commenced to use peroxide irrigation prior to employment of carbolic lotion, and again in a number of cases tested side by side, I found that the combination of both far exceeded that which was obtained by their separate use.   Some cases of streptococcic tonsillitis happened to be in hospital at the time, and the same experiment was carried out with a similar result.   We consider the joint use of both (gargle or spray every two hours) as specific in cases of common " sore throat."   I regret that I am unable to give any scientific chemical reason why peroxide of hydrogen and carbolic acid form such a good antiseptic tandem.

It may be of interest if I mention that, during the past ten years, there have been thousands of irrigations made with carbolic acid lotion in the British Hospital, and in not a single instance has carboluria been observed.

It is only right to mention that we have found eusol a useful application for some indolent wounds, particularly bed sores.

As to hypertonic solution, with its hydraulic paraphernalia (*Lancet*, October 16, 1915), it suffices to mention that, in 1898, we gave salt solution an ample trial, and found it absolutely useless, not to mention the waste of valuable time, and the supervention of an epidemic of sepsis which I have not seen the like of before or since.   I utterly fail to comprehend how anyone who has had any experience worthy of the term in the treatment of septic wounds can recommend such a procedure in the presence of virulent infection.

Some years ago I was induced by a paper of Sir William Watson Cheyne to give recent infected wounds one liberal saturation with pure carbolic acid.   For the first few days after each application we found that there was an apparent lull in the infective process, but, invariably by the end of a week or ten days, the germs of destruction were in full swing, and I came to the conclusion that such treatment only deferred the issue, and consequently was bad practice.

In spite of the good results reported from the use of pastes, powders and creams I remain skeptical as to their value, as they have proved in my practice to be worse than useless, in that they become converted within a short time into adherent masses of infective filth, which are most difficult to eradicate.

I hope Capt. d'Este Emery's report will tend to dispel another illusion. Many surgeons still advocate the use of strong mercurial lotion in septic wounds along with carbolic or peroxide or both, presumably with the idea that what one may miss the other may kill; if such is the basis of this practice, it strikes me as something akin to Lever's character at the Battle of Waterloo who slew friend and foe alike. I abandoned mercurial irrigation in the nineties, as I came to the conclusion that any substance which tends to form an albuminate in the tissues is a bad weapon to use against germs.

My clinical experience is quite in harmony with Capt. d'Este Emery's deduction that we should not employ any antiseptic that is easily quenchable, and I am of the opinion that the use of any chemical in any strength which may be deleterious to the vitality of the cells, or which may detract from the defensive properties of the serum, is only helping the enemy. Consequently, while I am a firm believer in the employment of " peroxide carbolic " lotions, I maintain that both should be used in a strength not sufficient to cause instant death to the invader, but sufficiently powerful to attenuate his virility or render the occupation of his trenches so uncomfortable, that, given a convenient loophole in the way of thorough drainage, he will clear out.

There seems to be a general consensus of opinion that free drainage is the primary factor in the treatment of these septic cases, and I wish to add that I am in complete accord with those who state that without a free exit for discharge antiseptics are hopeless, but I think it essential to emphasize the fact that the judicious use of an appropriate disinfectant is a most important life-saving secondary measure.

As to the best method of drainage, I know of none equal to that obtained by the liberal and well-applied use of a knife, and I strongly recommend that, when the general symptoms, as indicated by elevation of pulse and temperature, and coated tongue, are combined with a foul discharging wound, ether should be administered, tourniquet applied well above lesion, and a few, four to six incisions be made into parts in which fluctuation or bogginess is indicated on digital palpation, always carrying one or two such incisions into, or from, the original wound. The next move is to introduce the sense of sight into the business, retractors are applied, edges of wound drawn apart, and field mopped dry with gauze sponges. A careful inspection is then made of interior, while digital pressure is made all round exterior of wound; if any leaking into cavity is observed, a closed forceps or director is pushed into track, and secondary collection located, a direct incision is made into latter, and if there is no fear of anatomical sacri-

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lege, there ought to be no hesitation in extending this incision in such a manner as to throw pocket sinus and original wound into one open chasm. I consider it imperative that both daylight and eyesight should be introduced into septic deposits similar to the standard treatment of osteomyelitis in long bones.

When infection is confined to the subcutaneous tissues, one need not worry about drainage, if the incision is of such a size as to eliminate the possibility of retention of discharge underneath overhanging edges. The existence of latter, particularly at angles of wound, is proof that the incision is inadequate, and this must be at once corrected.

The cardinal factor in this treatment is the conversion of a septic cavity or cavities into one large open sore, and, in nine cases out of ten, if this is properly done, and followed by four hourly irrigation with hot " peroxide carbolic " lotions and hot fomentations, with absolute rest on a splint, the onset of repair is only a matter of hours, or at most a few days. When feasible, submersion in warm peroxide lotion, once or twice daily, is a useful adjunct.

When one has, for example, an infected compound fracture to deal with, more extensive measures are necessary. It may be stated that, with rare exceptions, when the seat of infection is situated beneath muscles or between muscular planes, drainage cannot be properly effected without the aid of gravity, and, in order to obtain this, a large counterincision must be made at the most dependent level, so that the discharge may fall out of the wound, something similar to what would happen if the bottom was knocked out of a pail of water. The object in view is to form an adit sufficiently large to look through, and which will insure instant automatic evacuation of infective secretion, as it is puerile to expect leucocytes and serum to put up any defence if they are allowed to be drowned in virulent reinfective material.

As there is always a tendency for the edges of tunnel wounds, irrespective of size, to adhere within forty-eight hours, I always pass two large rubber drainage tubes right through such wounds to act as props, in order to secure the subsequent patency of opening; these are changed on the second day, and, if the general and local conditions are satisfactory, the case is left in charge of the Sister, who continues four hourly irrigation and fomentations until the whole wound is free from pus, and covered with healthy granulations.

I now wish to invite attention to some details in this method of treatment:

(1) As a useful guide to a good counterincision, I have found a closed large straight blunt scissors a very handy weapon, which

can be safely pushed through the tissues, and when approaching the posterior subcutaneous area, expanded to the full (3 to 4 inches), thus indicating two definite distant points for one sweep of the knife. With the same scissors closed, as a blunt separator, the intervening tissues are promptly opened up to a diameter corresponding to the superficial incision.

(2) As to the method of irrigation suitable to cases in which there is always danger of contamination, particularly when a number have to be treated simultaneously in hospital, I strongly advocate the use of a one- or two-litre enamel jug, instead of irrigators or funnels with tubes and nozzles difficult to sterilize. I find that much more efficient lavage can be obtained by pouring the lotion in a steady flow from jug, and if the liquid issues from the counteropening in or about the same volume that it leaves the jug, one may rest assured that good drainage has been provided.

(3) It is most essential to apply a tourniquet in these cases, as otherwise the part becomes so obscured with blood and secretion that it is impossible to see what one is doing. I am certain that the omission of this simple detail has been responsible for the loss of many limbs. When the tourniquet is removed all spirting vessels are seized with forceps and ligated with fine catgut; any oozing which may continue is checked by the subsequent irrigation with hot " peroxide carbolic." If the latter should not be successful, I pack the bleeding area firmly with large bibules soaked out in hot peroxide; these are removed in six to twenty-four hours by irrigation and gentle traction.

(4) The limb is always fixed on splint by separate bandages above and below lesion, so that subsequent irrigation can be carried out without removal of splint, and soiling of latter is prevented by the insertion of a piece of rubber tissue between it and affected portion of limb.

(5) When possible all serious cases should be kept permanently in the open air under a shelter roof, and if champagne is procurable, a really desperate case should not be denied a few bottles of it.

(6) As to the after-treatment I insist on the necessity for absolute rest until the wound is healed. There is no more certain method of obtaining a protracted convalescence than a premature taking off of splints and getting out of bed. And any attempt to sidetrack the natural factors which govern the natural repair of wounds should be studiously avoided. I have seen lamentable results follow ill-timed and ill-applied massage, and ruin follow in the wake of what is euphoniously styled " passive " movements.

I wish also to state that I have no use for any kind of gauze drainage or packing while the septic battle is raging, and I have not the slightest doubt that the best results can be obtained by those who keep the ring clear of all foreign bodies, irrespective of their impregnation with emulsions or balsams.

So far little mention has been made of tubes for the purpose of drainage, the reason being that long experience has proved to me that tubes do very little draining, but form useful props to keep wounds patent for the evacuation of fluid, and also serve to establish a channel for drainage subsequent to their removal. In abdominal work I usually omit the tube on the second or third morning. This practice is the result of what I have over and over again witnessed—a considerable rush of pent-up liquid the moment the tube is removed; in other words, tubes, like gauze saturated with secretion, may act as corks, as well as irritating—if not infective—foreign bodies. But, as it is incumbent to provide some outlet in septic cases, one has to choose between the lesser of evils, and insert some kind of prop so as to prevent the wound from closing. I think it advisable to change the tube or tubes within forty-eight hours, and substitute a new one once or twice daily until the sixth day, when it should be dispensed with altogether. And in septic infection, other than abdominal, I strongly recommend lavage with " peroxide carbolic," each time a tube is taken out, and before a fresh one is inserted, so as to remove the secretion and débris which always hang about the track.

In order to obviate any misunderstanding I wish to mention that I rarely employ irrigation during operation in septic abdominal cases, as I am possibly obsessed with the dread of diffusing septic elements into the recesses of the abdomen. Instead I rely on thorough mopping up with dry bibules, and generally insert two large tubes right down to seat of infection. I think, in all such cases, that it is most essential to provide ample room around tube for free exit of secretion. The long diameter of opening left in parietal wall should be at least three times the diameter of the ordinary " gas pipe " tube employed. This may appear an exaggerated precaution at time of operation, but I am prepared to make a bet that it will not appear one bit excessive when wound is dressed, say six hours later. When the prop is removed on third morning, the factors which govern natural defence have encompassed the infected field with an adhesive barrier, which safely admits of gentle irrigation of cavity with peroxide carbolic lotions if such be considered necessary. Tight-fitting tubes in a septic abdomen are, in my opinion, a menace to the existence of the patient.

I am cognizant of the fact that this method of treatment of wound infection has, like many other things, its compensatory defect, in the way of large wounds which take a long time to heal, but this is of small import compared to the gain—a limb or life saved. Recently it has been suggested that, when such wounds are in a suitable aseptic state, secondary sutures should be employed, but there is always the difficulty of determining the opportune moment for such intervention in cases that have been once septic. I have on many occasions attempted to hasten matters in this way, and while I have had some highly satisfactory results, I must admit, that I have had more disappointing ones, an experience which justifies the inference that, in many wounds which appear microscopically free of infection, such a simple procedure as the insertion of a few sutures, under strict antiseptic precautions, evokes such an intense septic explosion that it is logical to assume that militant germs, phœnix like, are gifted with the faculty of resurrection from their own ashes. While I do not condemn the attempt to close such wounds by secondary suture, I think it right to add a word of warning, that the result of same may turn out to be the reverse of what one might reasonably expect.

As to the treatment of post-septic wounds, healing up by some intention, my favorite applications are " Lotio Rubri," Ungt. Boracic. (grs. x to ℥i), hot lead or boracic fomentations (ℨi of each to litre) applied three times a day, plus absolute rest on a splint until the wound is healed. This I combine with plenty of fresh air, and a glass or two of stout, beer, or good wine with meals.

ANGIONEUROTIC ŒDEMA WITH VISCERAL CRISES*

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ANGIONEUROTIC œdema, except in its manifestation as hives, is not of particularly frequent occurrence and certainly, if we can judge by the lack of literature and brevity of text-book articles, its visceral manifestations are but little known and understood. It is for this reason that the following case is considered worthy of report.

A young woman, twenty-one years old, single, a college student, was referred to me on August 25, 1916, by Dr. Becker, complaining of nausea, vomiting, obstinate constipation, severe headache and pain and tenderness in the right iliac region. Her illness began seven days before with a sore throat—the vomiting, constipation, headache and abdominal symptoms quickly supervened and persisted. Her abdomen was markedly retracted and quite rigid, with tenderness in the right iliac fossa and pain radiating to the epigastrium. No masses could be discovered, her spleen was not palpable and her liver was not enlarged. Over the upper portion of her abdomen were some rose spots suggestive of but not typical of typhoid. Her temperature was 98.8°, pulse 108 and respiration 26. Diastolic blood-pressure was 95 and systolic 120. The blood count was as follows: Leucocytes, 11,200; polymorphonuclears, 68 per cent.; transitionals, 1 per cent.; small lymphocytes, 26 per cent.; large lymphocytes, 3 per cent.; eosinophiles, 2 per cent. No plasmodia could be found and a Widal in a dilution of 1 to 40 was negative as was also a Von Pirquet. She had always been highly neurotic, subject to marked superficial vasomotor disturbances—as Dr. Becker aptly expressed it, you could write your name on her skin with your finger tip. For several years she had suffered with intermittent attacks of pain and tenderness in the right half of the abdomen.

Here then was a patient who had been ill a week with obstinate vomiting and constipation, a markedly rigid and retracted abdomen with tenderness in the right iliac region, severe headaches later developing quite a pronounced photophobia. Her mental condition was rather apathetic, but she could not sleep. Her temperature was 98.8° and pulse 108. Diagnoses of tubercular peritonitis,

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* Read before the Brooklyn Surgical Society, February 1, 1917.

typhoid, possible appendicitis, tubercular meningitis and a peritonitis secondary to the primary throat condition were all considered, but a definite diagnosis could not be made.

She was treated symptomatically, the nausea and vomiting gradually becoming less, headaches and iliac tenderness diminishing. The constipation remained obstinate, cathartics were almost without effect and enemata practically so. Small unsatisfactory movements could be obtained by a combination of both. The abdomen, however, became softer and less scaphoid. During this time there was an intermittent inability to urinate and a catheter had to be used.

Blood counts made on the third and seventh days showed a diminished leucocyte count, a smaller percentage of polymorphonuclears and an increase of large and small lymphocytes, up to 44 per cent. An examination of the eye grounds was negative. Her temperature varied from 97.8° to 100.4° and her pulse from 90 to 110, both becoming normal on the ninth day.

She was allowed to return home to be under the care of her physician on September 19, having been in the hospital under observation twenty-five days. But eight days later she was readmitted because of the persistent constipation and return of severe nausea.

An exploratory laparotomy was offered and readily accepted. A right rectus incision was made and the transverse and ascending colon were found practically in the pelvis but otherwise normal. A calcified gland was removed from the mesentery of the ascending colon, on which the pathologist subsequently reported that it was entirely degenerated, that no structure was visible and that it was possibly tubercular. The cæcum and first portion of the ascending colon were surrounded by a pericolic membrane but were not in any sense bound down by it. The appendix was long, thin, to the outer side of the cæcum and covered by the membrane. The appendix was removed together with the right ovary which was completely cystic.

A particularly careful examination was made of all the abdominal viscera with negative findings in all except the small intestine. This was everywhere pale, firmly contracted and ribbon-like and seemed to occupy but the central portion of the abdomen. Although the small intestine was firmly contracted the slightest traumatism with finger or instrument would cause a still further marked contraction for a distance of about six or eight inches. There was nothing even suggestive of obstruction in any part of either large or small bowel, the large bowel being about normal in size.

She made a perfectly satisfactory post-operative recovery, ex-

cept for the slightest kind of a superficial infection due to a small infolding of the skin. Nausea and vomiting were no more than usual following anæsthesia. She did, however, have a temperature which reached 101.6°, but which became practically normal before she was discharged on October 18th, twenty-one days after admission. Constipation remained persistent until she was placed on hyoscyamine and comphor monobromate which resulted in free satisfactory bowel movements. The use of antispasmodic medication suggested itself to us by the contracted and spasmodic condition of the small intestine as seen at operation, and the results certainly justified its use.

A blood count made seventeen days after operation was as follows: Red blood-cells, 3,900,000; leucocytes, 20,000; hæmoglobin, 75 per cent.; polymorphonuclears, 77 per cent.; large mononuclears, 0 per cent.; transitionals, 1 per cent.; small lymphocytes, 17 per cent.; large lymphocytes, 4 per cent.; eosinophiles, 1 per cent.

Shortly after her return home her temperature became 102.4°, she complained of considerable pain in her right iliac region and a tender doughy mass could be palpated here. The temperature gradually dropped to normal and the mass disappeared.

I was out of town and did not see her at this time, but cannot believe that the abdominal mass was inflammatory. The operation was a perfectly simple one with absolutely no soiling, and it is difficult to comprehend an abscess developing under these circumstances over three weeks after operation and then entirely subsiding. We believe that it was probably an œdema of the bowel similar in character to the cases described by Crispin in an article entitled " The Visceral Crises of Angioneurotic Œdema " (Collected Papers of the Mayo Clinic, 1915, page 823), in which he states "there is another type probably resulting from the same primary cause that is occasionally mistaken for appendicitis or appendiceal abscess in which the onset and disappearance of pain are more gradual. A swelling often appears in the lower right abdomen, which suggests appendiceal abscess. There may be increased temperature; the symptoms, usually of short duration, are out of proportion to the patient's general condition, which is fairly good. In operating on these patients a brawny induration, often of the whole cæcum and appendix, thick-walled and somewhat hard, is found."

Riggs (*Northwest Medicine*, May, 1915) also mentions a case in a male, twenty-four years old, complaining of epigastric pain, temperature 101° and a doughy mass at McBurney's point, and he quotes Sutherland, emphasizing the fact that the site of election for this form of intestinal hemorrhage, that is, a hemorrhagic condition of the bowel wall, is in the ileocæcal region.

At the time of the patient's first admission to the hospital and while we were endeavoring to make a diagnosis, the possibility of an intestinal crisis due to angioneurotic œdema was considered, but unfortunately we did not look up the literature as thoroughly as has been done since, and only being familiar with the short and unsatisfactory text-book descriptions dismissed the possibility from mind.

Subsequently all available literature was reviewed and we became convinced that it was a case of angioneurotic œdema and obtained the following additional information from her.

Her maternal grandmother died of tuberculosis. Her mother is a most neurotic individual with periods of great mental depression. The remainder of the family history is negative. The patient has never been strong and robust and from the age of three until fourteen she suffered with asthma. She states that until she went to college she never had a sick stomach, but about two years ago she had an attack of vomiting which lasted one week, was then well for one week and was then seized with a violent attack of abdominal colic. The pain was at first high and it was thought that she had pleurisy, but later it moved to the right iliac region. This illness was preceded by a sore throat lasting but a few hours. She has had three such attacks, though the abdominal pain was never so severe as in the first, always preceded by a sore throat of very short duration. In one attack her throat suddenly became very sore at 7 P.M. and she could not swallow, and at 4 A.M., nine hours later, her throat was perfectly well, but she began to suffer with severe abdominal pain. In between her attacks she has had practically constant abdominal discomfort shifting in character. In the intervals her bowels have been regular. She has never vomited any blood nor passed any by bowel. Her abdominal pain is usually worse at night and an acute exacerbation will usually begin about 10 P.M. Crispin states that the nocturnal exacerbations are frequent, and in one instance he observed a suggestion of regularity in the return of pain about the same time each night. She gives a history of one attack of bronchorrhœa lasting one day; a symptom which Halstead emphasized. She has never had the typical swellings but states that at times her lips have been red and swollen " as though she were about to have a cold," and that she frequently has red blotches on her neck and arms which burn but are not elevated nor swollen.

Following the operation she gained considerably in weight, but her symptoms of nausea and vomiting returned. Constipation again became troublesome until placed on hyoscyamine and camphor

monobromate and it was found that by increasing the dose a diarrhœa could be produced.

The text-books are so sterile on this subject that the following extracts from the literature seem worth while.

In Osler's article, " The Surgical Importance of the Visceral Crises of the Erythema Group of Skin Diseases " (*American Journal of Medical Sciences,* May, 1904), he states, " It is also to be borne in mind that recurring colic may be for many years the sole feature of this remarkable disease (angioneurotic œdema) as in cases Nos. 17 and 27 of my series, in which the obscurity of the attacks of colic was not cleared up until the final appearance of the skin lesions."

He further states, " the possibility of mistaking these visceral crises for appendicitis or intussusception or obstruction of the bowel and handing the patient over to the surgeon for operation is by no means remote," and still further (*American Journal of Medical Sciences,* January, 1904), " One of the most constant features of this whole group, occurring in twenty-five of the cases, is the recurring attacks of colic, sometimes with vomiting, sometimes with diarrhœa, occasionally with the passage of blood."

Crispin confirms Osler's observations and states " these visceral or gastro-intestinal crises may be so severe at first sight as to cause concern, and they may be without external clues in the nature of lesions of the skin."

Riggs cites several interesting examples of this condition : Two boys both with temperatures reaching 103 and remaining up for several days following operation.   In one " not only were no purpuric spots present but no angioneurotic nor urticarial symptoms were noted."

The abdominal pain complained of in these cases has been ascribed to a distention or stretching of the bowel wall due to the œdema, but as there was no œdema present in our case we believe that the symptoms were due to spasm, a pre-œdematous stage of angioneurotic œdema.

Following Crispin's article in the Collected Papers of the Mayo Clinic, 1915, is quite a complete bibliography of this most interesting condition.

STAB WOUND OF THE DEEP EPIGASTRIC ARTERY*

WITH COMMENTS UPON THE SURGERY OF THAT VESSEL

By Penn G. Skillern, Jr., M.D.

of Philadelphia

J. B., schoolgirl, white, fifteen years of age, was admitted to the Polyclinic Hospital on October 31, 1916, at 9.40 P.M., and discharged, cured, on November 26th.

History of Present Injury.—During a Hallowe'en frolic at 9.30 on the evening of admission—ten minutes before reaching hospital—the patient was stabbed in the abdomen by a fifteen-year-old boy, who wielded a new penknife with a blade 1½ inches by ⅜ inch. The patient experienced pain only when the knife was withdrawn.

Physical examination reveals an incised wound of the abdominal wall which involves the middle of the left rectus muscle just below the level of the navel. The direction of the wound is oblique, and the length is 1¼ inches. There is no protrusion of the omentum or of a viscus. On admission there was no undue amount of external bleeding from the wound, but after etherization was begun a smart amount of blood began to well up from the wound. The patient was not greatly shocked and there was no unusual abdominal rigidity previous to operation.

Operation.[1]—Ether anæsthesia. The stomach was washed out, and many masticated nuts were removed. A vertical incision, 4 inches in length, was made through the middle of the left rectus muscle, incorporating the stab wound. There was active bleeding from the stab wound, and the tissues bordering upon the latter were suffused with blood. On retracting the outer portion of the rectus muscle and inspecting its posterior surface the deep epigastric artery was found to have been severed in the stab wound and was still bleeding, though with diminished force. Both ends of the artery, together with its accompanying vein, were ligated. On incising the peritoneum blood-clots welled up, followed by the thin omentum. Evisceration of the movable intestines was rapidly performed, the coils being covered by hot, moist compresses. The blood-clots led down into the pelvic cavity, from which at

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* Read before the Philadelphia Academy of Surgery, January 8, 1917.

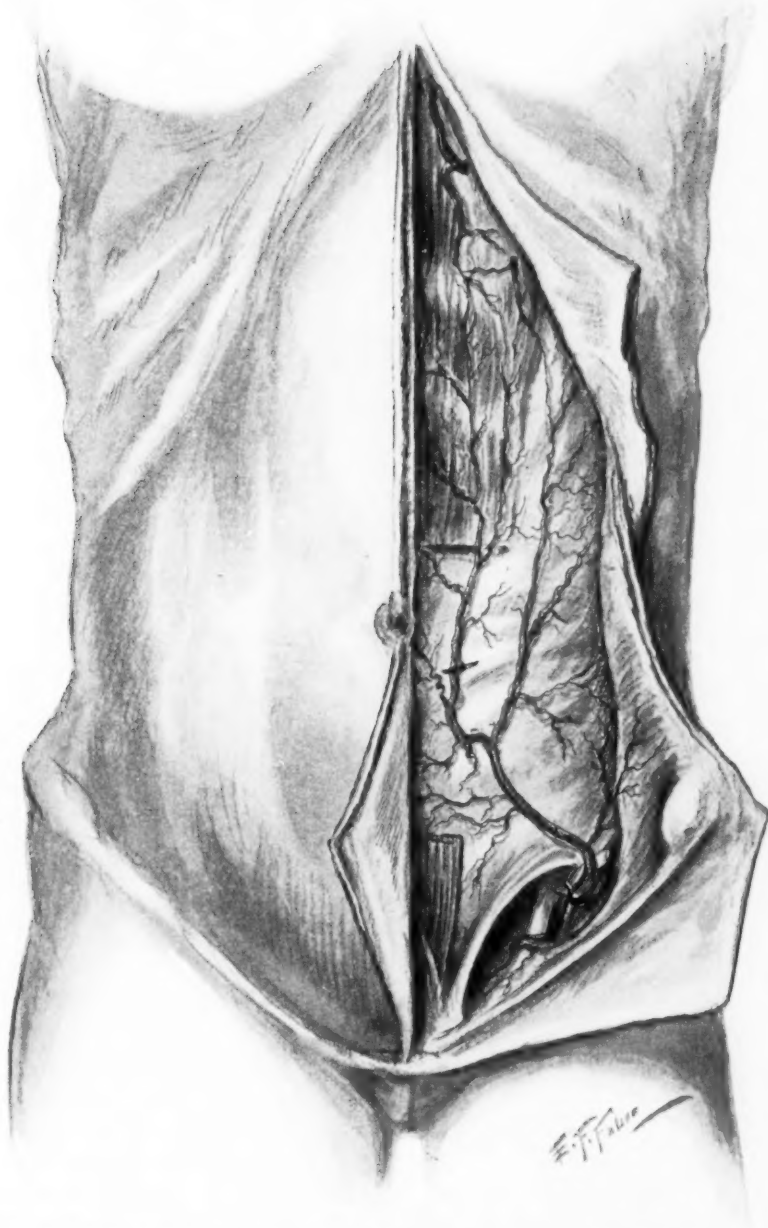[1] By Dr. Skillern in the absence of Professor Morris Booth Miller, upon whose service the patient was admitted.

FIG. 1.—Sketch from dissection by author of deep epigastric artery, showing its course, division into two trunks, branches of distribution and anastomoses. Below and to left of navel is shown the portion divided by the stab wound. The site of election for the application of a ligature is shown close to the origin of the vessel from the external iliac. The anomalous obturator vessel is shown better in Fig. 2.

least one pint of blood-clots was removed. Careful inspection of iliac arteries and veins and of vessels of mesentery and meso-sigmoid and omentum revealed no other source of hemorrhage; nor was gross injury to any viscus found; there were no fecal contents free in the abdominal cavity, nor was the gut collapsed at any point. Masticated nuts were felt along the course of the bowel and in the appendix. The eviscerated intestines were replaced. One pint of normal saline solution was placed and left in the abdomen. The wound was closed by tier sutures of chromic gut. No drainage was employed. Intravenous saline of 750 c.c. was given on the table.

With the exception of superficial infection of the stab wound convalescence was uninterrupted. On the sixth day after operation the patient passed a few old blood clots *per anum*. This suggested that the angular point of the penknife (Fig. 1) had inflicted a small incised wound in the wall of a coil of gut. This wound, however, must have been immediately closed by contraction of the muscular wall of the bowel aided by prolapse of the mucosa into the mural wound, for at the time of operation there were no signs of an unsealed perforation of the intestine.

The salient feature in this case was the concealed hemorrhage. Writing upon punctured wounds of the arteries of the abdominal wall Lidell [2] says: " When these arteries are opened by wounds which penetrate the abdominal cavity, and the apertures in the integuments are closed without first securing the wounded vessels, the blood may flow inwardly and collect in great quantity in that cavity; *this concealed hemorrhage may be so abundant as to prove fatal.*" That such a hemorrhage may prove rapidly fatal is shown in a case of perforation of the deep epigastric artery in the course of paracentesis for ascites.[3] In this case puncture was made at a point equidistant from the navel and anterior superior iliac spine. On withdrawing the trochar a small drop of blood appeared at the puncture orifice. Two and one-half hours after puncture the patient began to manifest signs of internal hemorrhage and died shortly afterward while waiting for a priest. At necropsy a large quantity of red and almost pure blood escaped from the abdomen —*about 4 litres. A great clot occupied the left iliac fossa.* The epigastric artery itself, and not one of its branches. was injured. Our patient was upon the operating table one hour after the stabbing. Concealed hemorrhage from such a wound may be checked and even prevented when, by a fortuitous circumstance, the omentum prolapses into

[2] Ashhurst's " International Encyclopædia of Surgery," 1883, iii, 129.
[3] Merle: Bull. et mém. de la Soc. anat. de Paris, 1907, 6 S, 9, 522.

the wound and acts as a natural hæmostatic packing. Such a case is reported by Hunter.[4]

> W. S., white man, age ——, in a fight a few hours ago, was stabbed with a short dirk in the abdomen. The knife entered about 1¼ inches to the left of the median line, a little below the level of the anterior superior process of the ilium. Cutting inward and upward diagonally across the fibres of the rectus muscle, the knife divided a branch of the deep epigastric artery and entered the abdominal cavity. The withdrawal of the knife was followed by considerable hemorrhage, but this was soon arrested by a piece of the omentum as large as the hand, being forced through the wound during the efforts at vomiting and coughing, which immediately succeeded the injury.

In our case the appearance of the usual signs upon which exploratory cœliotomy for perforating wounds is based was anticipated by immediate operation, which was based solely upon the surgical axiom that, given a penetrating incised, lacerated or punctured wound—especially in the region of important vessels, nerves, tendons, or viscera— the extent of damage done by the vulnerating agent can be accurately determined by exploratory operation alone. *In this case it was just as important to find out what the knife did not do, as it was to find out what it did do.* Thus, when the patient was first seen all that could be learned by inspection was that there was a penetrating wound which had divided the skin over the known course of the deep epigastric vessels; in order to inspect further we had to explore, and by exploring we found the deep epigastric vessels divided, the peritoneum opened, and hemorrhage taking place from the vessels through the rent in the peritoneum into the pelvic cavity. As to what the knife did not do we assured ourselves that it did not make a gross wound in the bowel, nor injure the vessels of the omentum or mesentery. Without exploration the true situation would have been but a matter of conjecture.

In the Medical and Surgical History of the War of the Rebellion, Part II, surgical volume ii, p. 9, Otis reports seven cases of secondary hemorrhage from gunshot wound of the deep epigastric vessels, of which five cases were fatal. He states, " Here, as in the management of bleeding from the wounded internal mammary and intercostal arteries, timid, inefficient, temporizing treatment appears to have been followed by lamentable loss of life. *The instances to be cited teach emphatically that wounds of the epigastric, circumflex, mammary, and lumbar arteries are not to be regarded as trivial, but demand the rigorous*

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[4] Maryland and Virg. M. J., Richmond, 1860, xv, 136.

application of the rules for the management of wounded arteries, the exposure of the bleeding point, and a proximal and a distal ligature."

Had operative interference been delayed in this case the concealed nature of the hemorrhage would, of course, have been indicated by pallor, by cold, clammy sweats, and by feeble pulse, along with sighing, thirst and restlessness. The accumulating blood gravitating to the pelvic cavity would have produced sensible enlargement of the hypogastric region, soft at first, and solid afterwards, and would have been detected by rectal palpation.

Boyer [5] speaks forcibly of the importance of ligation for hemorrhage from these wounds, and gives particulars of an instructive case of wound of the deep epigastric artery, that proved fatal, in which this measure had been neglected. Guthrie [6] several times saw this artery tied with success. In the case of a Portuguese soldier stabbed in the belly with a sabre, there was profuse hemorrhage from a small wound made by the point of the weapon. This wound Guthrie enlarged until the wounded but undivided artery became visible; upon this two ligatures were placed, and the external wound was sewed up. The man recovered.

SURGERY OF THE DEEP EPIGASTRIC ARTERY

According to Cunningham's description, the deep epigastric artery (Fig. 1) arises immediately above Poupart's ligament from the front of the external iliac. Curving forward from its origin it lies in the extraperitoneal fat, it turns round the lower border of the peritoneal sac, and runs upward and inward along the inner side of the internal abdominal ring and along the outer border of Hesselbach's triangle; it then pierces the transversalis fascia, passes over the semilunar fold of Douglas, and enters the sheath of the rectus abdominis. For a short distance it ascends behind the rectus, but it soon penetrates the substances of the muscle, and breaks up into branches which anastomose with terminal offsets of the superior epigastric branch of the internal mammary artery and with the lower intercostal arteries. At the internal abdominal ring in the male the vas deferens, the spermatic vessels, and the genital branch of the genitocrural nerve hook round the front and outer side of the artery, the vas deferens turning inward behind it; whilst in the female the round ligament of the uterus and the genital branch of the genitocrural nerve occupy the corresponding positions. The branches are muscular, cutaneous, cremasteric and pubic. The *pubic branch* descends on the outer or the inner side of or across

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[5] Cited by Lidell, *loc. cit.*
[6] Commentaries, etc., p. 510. Am. ed.

the crural ring to anastomose with the pubic branch of the obturator artery. Sometimes when the obturator branch of the internal iliac artery is absent, the pubic branch of the deep epigastric artery enlarges and becomes the obturator artery (Fig. 2), which descends to the obturator foramen, according to observations made by Jastschinski, along the outer border of the crural ring in 60 per cent. of the cases, this arrangement being more frequent in females; across the ring in about 22.5 per cent. of cases, again more frequent in females; and along the free edge of Gimbernat's ligament in only 17.5 per cent. of cases, this being more common in males. In the last two instances the artery may be injured in the operation for the relief of a strangulated femoral hernia.

The deep epigastric artery may be mapped out by drawing a line from a point midway between the anterior superior iliac spine and the symphysis pubis towards the navel. According to the dissection made by the writer (Fig. 1) the trunk of the deep epigastric artery, on reaching the outer border of the rectus, divides into two large branches, a mesial, which continues the course of the trunk upward through the rectus muscle, and a lateral, which bends laterally as it inclines upward, to supply the flat muscles of the flank. Both are shown in the cut anastomosing with the superior epigastric and lower intercostals.

The deep epigastric artery is but one of a series of what we shall term parietal vessels of the trunk, the others being the internal mammary with its perforating branches, the intercostals, the lumbar, the iliolumbar, the circumflex iliacs, and the superficial epigastric. Practically all these vessels are of surgical significance, the first in the operation of removal of the breast, the second in punctured wounds of the thorax and rib resection, and the last in herniotomy. All must be dealt with with wholesome respect, for practically all when opened and not tied are capable of terminating life by hemorrhage.

The deep epigastric artery is larger than it is commonly conceived to be. In the specimen from which the sketch (Fig. 1) was made the trunk was the size of the ulnar. It is accompanied by a single vein, although in some cases there are two veins. When the artery has been injured the hemorrhage may be checked by packing with iodoform gauze or by ligation. It is very easy to ligate the vessel close to its origin, as the writer found by investigations upon a series of cadavers. All that is necessary is to make a ¾-inch incision above and parallel with Poupart's ligament, and midway between the anterior superior iliac spine and the symphysis pubis. Cutting down through skin, both layers of superficial fascia (ligating the superficial epigastric), deep fascia and external oblique aponeurosis, the cremaster and arching fibres of the internal

FIG. 2.—Sketch from same cadaver as Fig. 1. The obturator is seen arising anomalously from the deep epigastric and descending in dangerous relation with crural ring to obturator foramen. The application of a ligature to this vessel at its origin is shown.
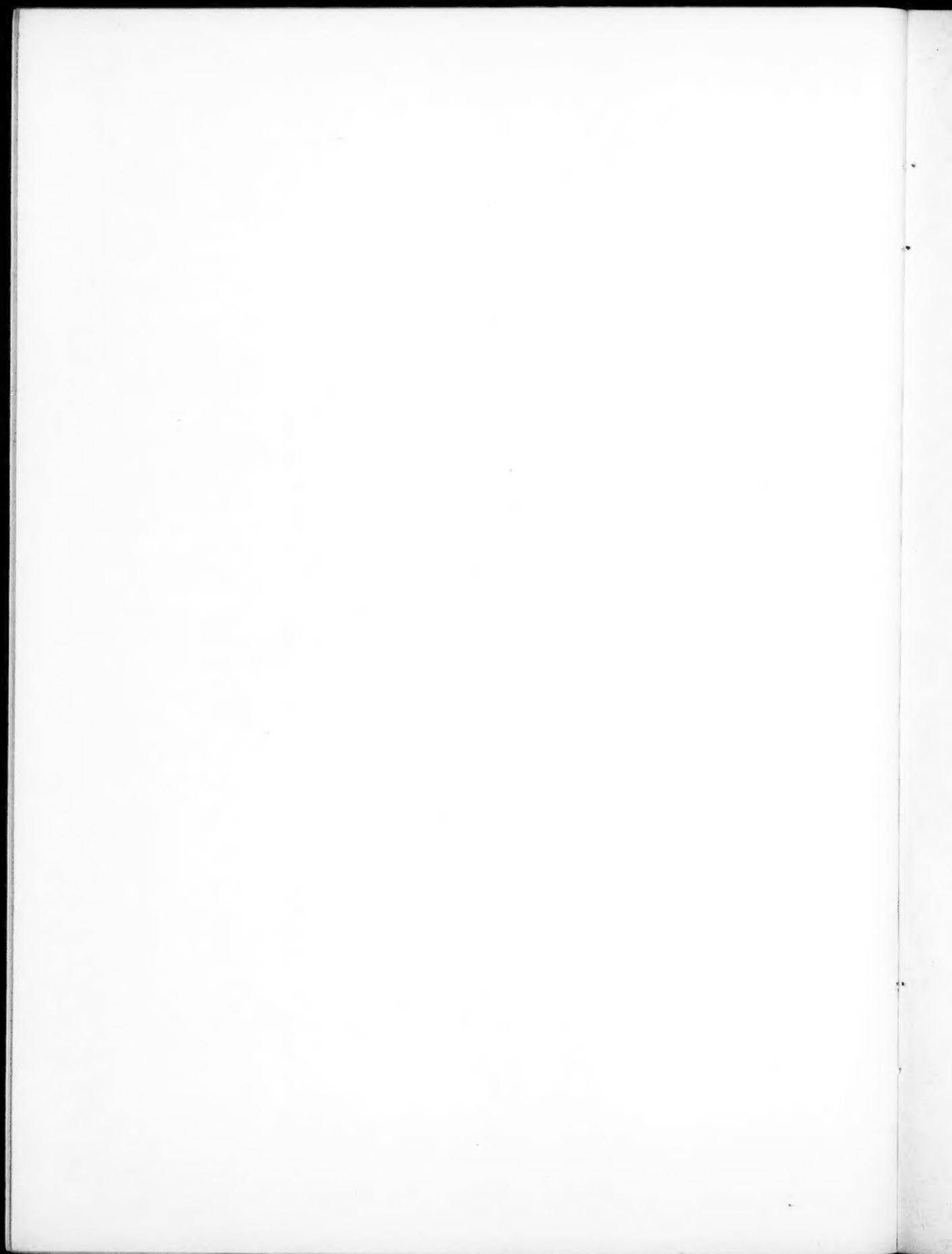
oblique are pushed upward and the transversalis fascia is incised, exposing the deep epigastric vessels in their first stage, and the ligature is applied as shown in the cut (Fig. 2).

The deep epigastric artery is involved in the following surgical conditions:

(1) Stab or gunshot wounds, already considered.

(2) Spontaneous hæmatoma of the rectus muscle, a case of which was presented before this Academy by Dr. John Speese.[7]

(3) Injury in paracentesis abdominis. This subject has been thoroughly worked up by Trzebicky.[8]

(4) Division during a cœliotomy incision. Here the conditions are the same as when the artery is divided by a stab wound, and they must be dealt with accordingly, remembering to ligate both ends.

(5) Postoperative secondary hemorrhage, especially in drainage cases. Here it is the custom to pack, but ligation of the vessel at its origin is both surer and safer, and prevents recurrence of secondary hemorrhage with possibly fatal results.

(6) Division of anomalous obturator artery when cutting Gimbernat's ligament to relieve the constriction of a strangulated femoral hernia. Since this accident cannot be foreseen when working from below, it may be avoided to some extent by dulling the blade of the herniotome, so that while it is sharp enough to divide the dense Gimbernat ligament, yet it is so dull that it pushes the artery before it. It should be borne in mind, also, that the merest nick of the constricting tissue is usually all that is necessary to enable the strangulation to be overcome. In case of uncontrollable hemorrhage from the vessel it must be ligated close to its orgin from the deep epigastric artery in the manner already described for the latter vessel, and as shown in the sketch (Fig. 2).

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[7] ANNALS OF SURGERY, February, 1916, 245.

[8] Archiv f. klin. Chirurg., 1890–1891, xli, 850–65.

RETROPERITONEAL HERNIA INTO THE DUODENAL FOSSÆ

By Patrick I. Nixon, M.D.

of San Antonio, Texas

The case reported in this paper is unusual enough to justify putting it on record. Its study adds nothing in particular to our knowledge of the diagnosis or treatment of a rare and oftentimes very serious condition. Its report on the contrary is intended to distract our attention for the moment from the usual intra-abdominal lesions, the diagnosis and treatment of which is well standardized, and to act as a reminder that we as surgeons should be prepared to recognize and deal with the unusual conditions which any of us may encounter.

Until a few years ago my knowledge of retroperitoneal hernia was most hazy; at that time the tragic death of a young medical student from this cause brought the subject very vividly to my attention, and had it not been for the experience gained from this case the outcome of the case with which the present paper deals might have been different.

The history of the case is as follows:

P. P., man, aged thirty, had enjoyed the best of health till three years ago. He then began to have abdominal attacks which were diagnosed appendicitis by several competent men. These attacks occurred every two to eight weeks and lasted two to five days. They were characterized by colicky pains in the epigastrium which usually became localized in the right iliac fossa; nausea which was only occasionally accompanied by vomiting; fever which ranged from 99° to 100°. The onset of these attacks was usually gradual, being attributed oftentimes to some dietary indiscretion, but not infrequently they passed off quite abruptly. Two weeks before he was seen he had an attack, and again three days before another attack which had practically subsided. The bowels had moved from cathartics.

On examination of the abdomen at this time, there was not much to be made out. Two slightly tender areas were present, one at McBurney's point and another at a point slightly above and a hand's breadth to the left of the umbilicus. No muscular rigidity and no masses were felt. The temperature was 99° and the pulse 80. The urine was normal.

No preoperative diagnosis was made. Appendicitis naturally suggested itself. An operation was done for exploratory purposes.

A long right rectus incision was made. The appendix was free from inflammation and adhesions; it was removed. The gall-bladder, stomach and duodenum were quite normal. On following the ileum from the cæcum one encountered a very unusual condition: it was what at first appeared to be an enormously dilated stomach. On closer inspection it proved to be a semitransparent sac through which could be seen numerous coils of small intestine. This sac extended into the left flank and downward to the pelvic brim, where it was loosely adherent. The transverse colon lay above the sac and the descending colon behind it. The sac with its contents was about the size of an adult's head.

With the hand far back in the flank, the entire mass was pulled out of its bed and brought into the incision. It was not until then that the exact nature of the condition was recognized; this was made possible by passing the hand from the right side downward and to the left, when the finger entered a rather tight ring from which two loops of small intestine were seen to emerge. One of these became continuous with the duodenum and the other with the cæcum; both were empty, as was also the colon. Slight stretching of the neck of the sac and gentle traction on the cæcal loop brought about reduction of the entire, moderately distended small intestine. The proximal four or five feet of jejunum was intensely congested and its lacteals were dilated; this condition soon returned to normal. Within a few seconds after reduction of the hernia, the transverse colon had become markedly distended with gas.

On the anterior surface of the neck of the sac there was a large vein, probably the inferior mesenteric. Just distal to this vessel the sac was quilted back and forth and tied loosely. It was thought best not to excise the sac.

The patient made a quick recovery and has remained quite well since the operation.

Etiology.—Our knowledge of retroperitoneal hernia is based principally on the exhaustive monograph of Moynihan and Dobson [1] published in 1906. This condition is usually due to the peritoneal folds and fossæ. There is a difference of opinion as to whether these folds are congenital or are due to traction; Moynihan leans to the latter view. Primrose [2] has recorded a case due to an aberrant middle colic

artery. In the region of the duodenum Moynihan and Dobson describe nine fossæ: (1) Superior duodenal; (2) inferior duodenal (fossa of Treitz); (3) paraduodenal (fossa of Landzert); (4) mesentericoparietal (fossa of Waldeyer); (5) mesocolic; (6) posterior duodenal; (7) duodenojejunal; (8) intermesocolic; (9) infraduodenal. Of these the last four are unimportant and oftentimes absent. The third and fourth are the ones most often implicated in the formation of hernia, giving rise respectively to left duodenal and right duodenal hernia. The former of these has the inferior mesenteric vein, often accompanied by the left colic artery, on the anterior margin of the neck of the sac; the latter has the superior mesenteric artery in a corresponding position.

The exact mechanism of production of this type of hernia is not altogether clear. It is difficult to explain why hernia in this region is so infrequent when one or more fossæ are constantly present. It is well known that in practically every case one finds a vessel of greater or less size and importance in the free border of the original fold. It would seem that the location and laxity of this vessel is the predisposing cause of hernia formation: if this vessel is small and closely applied to the underlying tissues with a resultant fossa that is shallow, the likelihood of hernia is remote; on the contrary, if this vessel is large and lax with a resultant broad fold and deep fossa, the constant boring, peristaltic action of the intestine may gradually deepen the preëxisting fossa until the sac of considerable size in produced. Into this sac a part or whole of the small intestine may pass; Freeman[3] has reported a case where the sac contained the cæcum and part of the colon as well.

Incidence.—These herniæ affect all ages and conditions of man; they occur in the young and the old. Brösieke[4] has recorded an example in a child fourteen days old; this case is a potent argument for the congenital origin of the condition.

Moynihan and Dobson were able to collect from the literature sixty-five cases of left and seventeen cases of right duodenal hernia. In addition there have been a few instances of the rarer types. Since the report of these cases, Short[5] has collected fourteen cases of the former variety and one of the latter. There are three cases reported in American literature which Short has omitted; these are by Davis,[6] Primrose,[2] and Nuzum and Nuzum.[7] The first and last of these are the more frequent left duodenal type. Primrose's case is unique in that it was due to an aberrant middle colic artery, an extremely rare

anomaly; indeed, one doubts whether there is any justification for grouping it with duodenal hernia.

There are, then, eighty-one reported cases of left and eighteen of right duodenal hernia. No doubt cases have gone unrecognized and Short very aptly remarks that some fatal cases have probably passed unrecorded.

Diagnosis.—It will easily be seen that a correct diagnosis is most difficult. The symptoms for the most part are the symptoms of intestinal obstruction and naturally the various causes of obstruction must be differentiated. And after all, when a diagnosis of intestinal obstruction is once made, one is not justified in delaying in the hope of recognizing the underlying cause. Davis is of the opinion that " under favorable circumstances it is possible to make a probable diagnosis during life." He quotes Leichtenstern: " The circumscribed globular distention of the mesogastrium with retraction of the region corresponding to the colon; the firm, elastic, spherical lump which can be distinctly felt when the abdominal wall is thin, giving the impression of a large, somewhat movable cyst and extending from the mesogastrium to the left; the peculiarity that this well defined tumor always yields a sonorous note on percussion and clear intestinal sounds on auscultation, also the presence of hemorrhoids and the loss of blood from the rectum in consequence of the compression of the inferior mesenteric vein, permit, when taken in connection with the subjective troubles indicating chronic disease of the abdominal organs, a probable diagnosis to be made."

Moynihan states that " so far as the symptoms of the hernia are concerned there is little to be said. They may be slight or they may be the sudden symptoms of acute intestinal obstruction which swiftly strike the patient down. In a number of carefully recorded cases, the history of chronic slight digestive or intestinal troubles is usually obtained."

In direct contrast to those cases that have resulted in intestinal obstruction, mention should be made of a smaller group in which few or no symptoms are present; these cases are discovered at autopsy or during a routine examination of the abdomen at operation. The absence of symptoms, just as in any other type of hernia, is dependent on the absence of strangulation.

Ample proof of the difficulty of diagnosis is supplied by the fact that no recorded case—with one possible exception—has been diagnosed before operation.

Treatment.—The treatment of this condition is the treatment of intestinal obstruction plus certain measures directed toward the hernia itself. The general condition of the patient will be the determining factor as to how much or how little should be done: enterostomy, on the one hand, may be the operation of necessity; or reduction and cure of the hernia, on the other, may be the procedure of choice.

With the abdomen open and the condition recognized, an attempt at reduction should be made by combined pressure on the sac and gentle traction on the afferent and efferent loops of intestine. Careful stretching of the neck of the sac may be an aid to reduction. Fortunately these simple measures will suffice in a great many cases. If they should fail, the sac should be opened well above the constriction and further attempts at reduction made. Finally, and this is particularly applicable in tightly strangulated cases, the intestines should be withdrawn through the opening in the sac, several small incisions made and the intestinal contents siphoned off; this procedure will permit of reduction of the traumatized intestine in difficult cases. Viability of the contained loops will determine what disposition should be made of the intestines.

Too much emphasis cannot be laid on the statement that the neck of the sac cannot be enlarged by actual incision, because of the close relationship of the inferior mesenteric vein in the one case and the superior mesenteric artery in the other. Division of either of these vessels would very probably eventuate in gangrene of a segment of intestine. There is on record one case, however, in which the operator divided the inferior mesenteric vein which he afterwards found to be thrombosed [8]; it is possible in this case that the occlusion of the vessel was sufficiently slow to allow the collateral circulation to develop.

After the hernia is reduced an attempt should be made to close the neck of the sac, due respect being paid to the neighboring blood-vessels. It is preferable to ligate the sac distal to the vessels rather than run the risk of tying or injuring one of these. Paton [9] has recorded a case where recurrence followed failure to close the sac.

Prognosis.—The prognosis of duodenal hernia is only relative, just as is the prognosis of intestinal obstruction. Early diagnosis and early operation will make possible a favorable outcome. These two factors are probably responsible for the improvement in recent statistics. Out of sixty-five cases of left duodenal hernia collected by Moynihan and Dobson up to 1906, only eight of those operated on

recovered. Whereas of the eighteen subsequent cases at least ten have recovered.

The prognosis in right duodenal hernia is far more grave than in left. Of the eighteen reported cases there has been only one recovery.

REFERENCES

[1] Moynihan and Dobson: Retroperitoneal Hernia, 2nd Ed., 2, 1906.
[2] Primrose: Jr. A. M. A., lxiv, 1914, 842.
[3] Freeman: Tr. Amer. Surg. Assn., 1903.
[4] Brösieke: Quoted from Davis.
[5] Short: Brit. Jr. of Surg., iii, 1915, 48; *ibid.*, iii, 1916, 569.
[6] Davis: Boston M. and S. Jr., clxx, 1914, 272.
[7] Nuzum and Nuzum: Tr. Chi. Path. Soc., ix, 1914, 191.
[8] Haberer: Quoted from Jacobson & Rowlands. The Operations of Surgery, Fifth Ed., 1911, 270.
[9] Paton: Quoted from Jacobson & Rowlands, p. 271.

ISOLATED ABSCESS OF THE LIVER COMPLICATING APPENDICITIS

BY HENRY OTTO BRUGGEMAN, M.D.

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THE liver complications of appendicitis range from a banal icterus to acute yellow atrophy. It is probable that the functions of the liver are perturbed in every case of appendicitis. Credit must be given to the French clinicians for appreciating the importance and variety of these complications. Dieulafoy's term, *La foie appendicularie,* expresses a conception of a relationship between inflammations of the appendix and the liver which has received but scant attention in America. The most important and best recognized hepatic complication of appendicitis is liver abscess. Reginald Fitz in his notable contribution to the subject of appendicitis discussed this complication. We now know that in the non-tropical countries appendicitis is the most common cause of hepatic abscess.

The classical description of appendicular hepatic abscess presents the picture of a condition with a fulminating symptomatology and a fatal termination. Most authors have accepted the teaching of Dieulafoy who, in his " Leçons Clinique," said that hepatic abscess secondary to appendicitis is always fatal. When Loison, in 1900, reported a case with recovery to the Paris Society of Surgery, Poirier and Tuffier questioned the diagnosis. Gerster speaks of the " utter hopelessness of the malady." Deaver states that he has never seen recovery occur. In 1912 Franke remarked that one can almost say that these pylephlebitic abscesses have an absolutely unfavorable prognosis " because they are always multiple." In May of the present year Lissner wrote: " Surgical interference, however thorough, will not save the patient when once the infection has reached the portal vein."

A patient of mine with appendicitis developed an hepatic abscess without exhibiting any grave symptoms and he completely recovered from his malady. The history is as follows:

A. M. D., a male, aged forty, and a carpenter-contractor by occupation, had a negative family history. He was ill four weeks in 1909 with what was diagnosed typhoid fever. He had a second attack of the same disease in 1913 that lasted nine weeks. He

was a heavy whiskey drinker, otherwise his previous personal history was uninteresting. On March 17, 1916, he developed severe colicky pains in the abdomen accompanied by vomiting. There was no recollection of localized pain. He continued working. March 23, he had another severe attack of abdominal pain and vomiting. On the night of March 24, he was awakened by excruciating, griping, abdominal pains that radiated to the penis. Vomiting occurred. Dr. C. M. Glock was called, and a diagnosis of appendicitis was made. Patient entered St. Joseph's Hospital on the morning of March 25. When I examined him at the hospital he presented the following symptoms: Temperature 100.2° F.; pulse-rate 86; rigidity of right lower abdominal quadrant; tenderness over appendix; moderate distention. He had a slight cough and some expectoration.

Operation.—Right rectus incision. Small amount of pus, well localized, was sponged out and a partly necrotic appendix removed. The appendix was adherent and directed downward and inward; its removal was fairly difficult. Split-rubber drain inserted.

March 28: Temperature normal. Drain removed. Considerable cough and expectoration. For the next two weeks the history was uneventful; the drainage which had a fecal odor steadily diminished in amount. Cough and expectoration continued.

April 13: Temperature 101.4°; pulse-rate 90. Complained of vague distress in lower part of right chest. Dressing presented a small amount of brownish discharge. During the following three weeks the evening temperature varied from 101° to 103°, and the pulse-rate ranged from 80 to 96. Wound healed completely and patient insisted on moving about his room. At times he complained of dull pains and distress in hepatic region. Râles were detected over the base of the right lung.

April 21: He presented a slight general jaundice; the right lobe of the liver was palpable and tender two fingers-breadth below the costal arch.

April 22: A blood examination showed 12,300 white blood-cells with 74 per cent. of polymorphonuclears. Urine contained biliary pigments, otherwise normal. Fæces negative. Liver continued to enlarge until the right lobe was palpable a hand's breadth below the costal arch.

May 4: A tender fluctuating swelling was detected over the lower border of the liver.

May 5: Under ether anæsthesia an incision was made over the swelling and a large quantity of greenish-yellow pus welled forth. An opening into the liver that admitted the index finger was

revealed. An effort to examine the abscess cavity in the liver was checked because of the profuse hemorrhage that resulted. Large tubular drain was inserted into the abscess cavity. Patient made an uneventful recovery. Discharged from hospital May 25, with wounds all healed and liver palpable about two fingers-breadth below the costal arch.

Before the onset of jaundice and enlargement of the liver I believed that his complications were pulmonary. Later, owing to the mildness of his symptoms, his alcoholic history and my own ignorance of the type of liver abscess under consideration, I was inclined to make a diagnosis of an acute hepatic cirrhosis.

This case is not unique and its history is fairly typical of solitary abscess of the liver of appendicular origin. In 1911 E. Quénu and P. Mathieu reported a similar case and wrote that they had searched the literature and, including their own and two unpublished cases of Jalaguier, they had records of fourteen cases with operation, twelve of which recovered and two died of other complications. Three of the fourteen cases, however, probably had subphrenic and not hepatic abscesses. These authors did not exhaust the literature for they did not mention Parker Syms, Emanuel Herzel (Gerster), Munro, Sheen and Morton (Thompson), Hermes, Delangeniere (Abbadie), Elsberg, Perman (Carlson), Makrowski, Bidwell and Mgaloblischwli (Walter-Sallis), each of whom is to be credited with one operative recovery, nor J. Jason Clarke who reported two cases with recovery. Since 1911 Bittner, Brogden, Le Petit, Franke and Kelly have reported recoveries after operation.

In order to understand the pathogenesis of this affection one has but to recall that the appendix is richly supplied by veins and that blood from the appendiceal region pours directly into the liver. Practically it is impossible to separate this subject from that of pylephlebitis. Thrombophlebitis is an ordinary event in the course of inflammations of the appendix. There is nothing peculiar about the formation and character of these thrombi. In very rare instances a thrombus may form and extend through the portal vein, causing an abscess of the liver by direct continuity. Thompson, however, described a case in which there was no abscess of the liver although the branches of the portal vein in the liver substance were filled with pus. The commonest occurrence is for small septic emboli to become detached from a thrombus in the immediate neighborhood of the inflamed appendix and to travel through the superior mesenteric and portal veins to the liver. Usually such emboli are abundant and highly septic, so wide-

spread abscesses of the liver and death of the patient result. This is the classical hepatic complication of appendicitis. But, as in dysentery, a single embolus may be transported to the liver and a solitary abscess develop. Or, as Quénu and Mathieu have insisted, an aseptic embolus may reach the liver and produce a focus of necrosis which is capable of being infected in the course of a bacillæmia. In Jalaguier's case a syphilitic gumma played the rôle of a *locus minoris resistentiæ* and was infected during the course of an appendicitis. Loison showed that emboli can go from the region of the appendix to the liver without causing visible changes in the veins.

The abscesses of the liver usually occupy the right lobe. This is due chiefly to the distribution of the branches of the portal vein. Sérège (Quénu and Mathieu) seems to have proved by means of injections of Chinese ink that there are two currents of blood in the portal vein; one from the superior mesenteric, which goes to the right lobe, and one from the inferior mesenteric and splenic, which flows to the left lobe. It should be noted, however, that the left lobe alone may harbor the abscess.

We must admit that occasionally the infection travels to the liver along other avenues than the portal vein. It is possible that in rare instances infection takes place by way of the lymphatics. Munro has pointed out that the hepatic infections are not uncommonly associated with a lymphangitis, although the latter is not the source of the abscess in the liver. Koerte and others have believed that in certain cases the infection had journeyed to the liver along the retrocolic area. Out of eighteen cases studied in the Lund-Malonöer clinics (Petrén) it seemed that in one the infection had travelled along the retrocæcal way. Retrocolic infections are more likely to result in subphrenic abscesses. It must be a rare event for a subphrenic abscess to result in an hepatic abscess, but it is not so rare for subphrenic abscesses to result from hepatic abscesses. We have already considered the possibility of a bacillæmia causing an hepatic infection; however, when the infection takes place by way of the arteries it is usually but one of the manifestations of a general pyæmia.

In typical cases symptoms of these localized suppurations are quite unlike those of multiple liver abscesses. The onset of the latter is with chills followed by a rapid rise of temperature and grave general symptoms. The former starts less abruptly and usually does not display anything characteristic in its symptomatology. After a variable period an appendicitis patient presents some rise in temperature; jaun-

dice, hepatic pain and tenderness and some increase in the size of the liver may be present. Quénu and Mathieu have emphasized the occurrence of a free interval when the temperature may return to normal, the appendix signs clear up, but the general condition remains unsatisfactory; finally the liver signs suddenly appear and the diagnosis is made. Unfortunately, many cases are not typical in their symptomatology and I cannot agree with the opinion of Quénu and Mathieu that the surgeon should be able to distinguish between these different types of hepatic suppuration. One can draw no positive conclusions from the time of onset or the latent period, the only certain method of differentiating is to open the abdomen and examine the liver.

Loison utilized the X-ray in making his diagnosis; various writers have conceded the diagnostic value of a Röntgen examination, but they do not seem to have employed it in their own cases. Exploratory puncture is generally condemned by American surgeons, although Koerte, Clarke, Kelly and others have resorted to this procedure in making the diagnosis.

When a solitary liver abscess complicates appendicitis, it is fair for us to assume that we are dealing with a mild infection. It is also reasonable for us to believe that any damage to the liver parenchyma would predispose to the occurrence of such an abscess. Jalaguier's patient with a gumma illustrates this point. Chloroform anæsthesia, which has a particularly injurious action on the liver substance, and alcohol must be regarded as predisposing factors. Walter-Sallis cannot accept the idea that the infection is facilitated by alcoholism, but Petrén showed that four-fifths of the appendicitis patients who develop liver abscesses are males and he quotes LeGrand as proving that alcohol is a prime factor in the cause of amœbic abscess of the liver.

The case reports and the autopsy records, especially those studied by Loison, indicate that in the majority of instances the abscess is situated superficially on the convex surface of the liver.

Munro writes: " The age at which these infections take place is limited mostly to young adults. According to statistics of Musser and others, children below fifteen are quite exempt from portal infections." Petrén's statistics clearly show that appendicitis patients between the ages of thirty and fifty are most liable to develop liver abscesses. It is a striking fact that proportionately a very large percentage of children have developed the isolated abscesses. Clarke's patients were both boys of less than nine years of age.

Early operations have made hepatic abscess a very infrequent sequel

of appendicitis. Babler states: "Murphy maintains that multiple abscess of the liver are a rare complication of appendicitis. Oschner, Deaver and several other prominent American surgeons have not seen more than one case." Recently Stillman discussed the post-operative sequelæ in 1748 cases of appendicitis; 124, or about 7 per cent., had sequelæ and of these 2 cases presented liver abscesses. The solitary forms constitute but a very small percentage of the total number of liver abscesses; however, their rarity does not excuse the surgeon if he fails to consider them when his appendicitis patients present an unexplained rise of temperature.

Eminent pathologists have taught that resorption of liver abscesses occurs. Munro held that the spontaneous healing of the liver abscesses which complicate appendicitis is not impossible. Hellström, in his admirable " Arbeit," proves that spontaneous resorption, even of the multiple abscesses, has occurred.

The treatment is purely operative. The conduct of the operation is the same as for hepatic suppurations of a different etiology; so far as recoveries are concerned the honors are equally divided between the transpleural and the abdominal routes. If one suspects an intra-hepatic collection of pus which cannot be localized the liver should be exposed by a large abdominal incision and carefully explored. Wilms is given credit by the European writers for advising the ligation and ablation of the mesenteric veins leading from the infected area, but Gerster first advised and practised this procedure; however, it is probably without value.

BIBLIOGRAPHY

Abbadie: Thèse de Bordeaux, 1903.
Babler: ANN. SURG., 1915, lxi, 589-596.
Bidwell: Brit. Med. Jour., 1910, iii.
Bittner: Wiener klin. Wochen., 1912, 187.
Brogden: Lancet, 1911, i, 301.
Carlson: Hygeia, 1906, Bd. 68.
Deaver: Surgery of the Upper Abdomen, ii, p. 166.
Dieulafoy: Semaine Méd., 1898, p. 449.
Elsberg: ANN. SURG., 1906, ii, 219.
Fitz: Amer. Jour. Med. Sc., 1886.
Franke: Muenchen med. Wschr., 1912, lix, 2107.
Gerster: N. Y. Med. Record, June 27, 1903.
Hellstrom: Beitr. z. klin. Chir., 1912, lxxx, 546-562.
Hermes: D. Ztsch. f. Chir., Bd. 41, p. 459.
Kelly: Jour. Roy. Army Med. Corps, 1913, xxi, 688.
Koerte: Beitrage z. Chir. d. Gallenwegs u. der Leber.

Le Petit: Rev. de Chir., 1912, p. 758.

Loison: Rev. de Chir., 1900, i, 522; Bull. et Mém. de la Soc. de Chir. de Paris, 1900, T. 26.

Makrowski: Zbl. f. Chir., 1908, ii, p. 1255.

Munro: ANN. SURG., 1905, xlii, 692.

Petrén: Beitrage z. klin. Chir., 1914, xciv, 225-267.

Quénu and Mathieu: Rev. de Chir., 1911, xliv, 519.

Stillman: Med. and Surg. Rep., Roosevelt Hosp., 1915.

Syms: ANN. SURG., 1909, xlix, 857.

Thompson: Boston City Hosp. Rep., 1902.

Walter-Sallis: Rev. de Chir., 1914, xlix, 181-201 and 649-688.

Wilms: Zbl. f. Chir., 1909, p. 1041.

A NEW OPERATION FOR PROCIDENTIA UTERI

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Many different operations have been described for the surgical correction of this frequently encountered condition, a fact which implies the generally unsatisfactory nature of the results obtained. I myself have employed several of the described methods which I deemed to be the best, but have met with indifferent success, the operations being followed by a return of the prolapse, with its accompanying cystocele and rectocele, and in some cases there is a tendency of the entire trouble to return. At first I assumed that my technic was at fault, but, upon further investigation, found that men who have performed numerous operations of a like nature have encountered similar difficulties. Surgeons of wide experience complain that no entirely successful procedure is afforded at present.

I have recently devised an operation for procidentia uteri which has met with a greater measure of success than any other which I have previously employed. I believe this method which I now describe is in some degree original, and offer it for what it has been worth to me. If it dispenses with some of the difficulties experienced in the use of other methods (as it most certainly *has* done in my own practice), I believe it to be worthy of note.

The first step in the procedure is quite orthodox, and is accomplished as described in the text-books. I refer to the amputation of the cervix, concerning which I need only to advise that care be taken to avoid cutting the bladder. As is well known, in exaggerated cases of procidentia uteri, the uterus drags the bladder and the rectum down with it, and this condition is corrected, as will be explained in a later stage of the operation, by drawing up, and fastening in the abdomen, the body of the uterus.

After the amputation of the cervix has been accomplished, and the repair work on the perineum completed, the abdomen is opened in the median line as usual, the incision penetrating through skin, connective tissue, aponeurosis of the rectus muscle, and peritoneum. This incision should be free and large, and the intestines walled off with packing gauze, so that the operator may not be hampered in the inspection and manipulation of the parts to be attacked. In the

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majority of cases, anatomical conditions are normal in the abdomen, and the following steps of the operation can be accomplished without difficulty.

The operation proceeds now as in the usual hysterectomy, the round ligaments, broad ligaments and Fallopian tubes being severed, and the peritoneum sewed down to the attachment of the bladder and around the cervix. This stage of the procedure is clearly demonstrated in Fig. 2, which shows the tubes and ligaments tied off, and the sutured peritoneum in place.

Up to this point the operation has been familiar enough. The next step I believe to be original. The uterus is split longitudinally downward, to the point where the bladder is attached to the cervix, and the endometrium dissected out, from each cut section. Two incisions are now made through the aponeurosis and body of the rectus muscle, and through the peritoneum; each incision being distant one-half inch from the central incision through the rectus muscle, and each running in a direction parallel to it (the central incision). Each of these incisions should be large enough to permit one segment of the bisected fundus to be drawn through it. The position and purpose of these incisions are shown in Fig. 4 more clearly than can be described in writing. *A* is the central incision, *B* and *C* are the two side incisions, which positions are described above.

When these incisions have been made, a pair of vulsellum forceps is inserted through each, and the segments of the divided uterus are drawn through the apertures. The central incision through the rectus muscle and peritoneum is sutured, and the two parts of the uterus are brought together, being then sewn over the now united aponeurosis and muscle. The position and appearance of the uterus at this final stage may be likened to that of a finger ring. The uterus itself being the ring, its fundus taking the position that a stone in the ring would assume (that is, on the *dorsal* part of the finger), the cervix being that part of the ring upon the palmar surface of the finger. The rôle of the finger itself is played by the sutured central incision. It is now obviously impossible for the uterus to become displaced, and the skin and connective tissue are closed in after the usual fashion, over the fixed fundus of the uterus. The operation is now completed.

I have performed many other operations for this unfortunate condition, but the results have always been unsatisfactory and disappointing, whereas with this method, I have been universally successful.
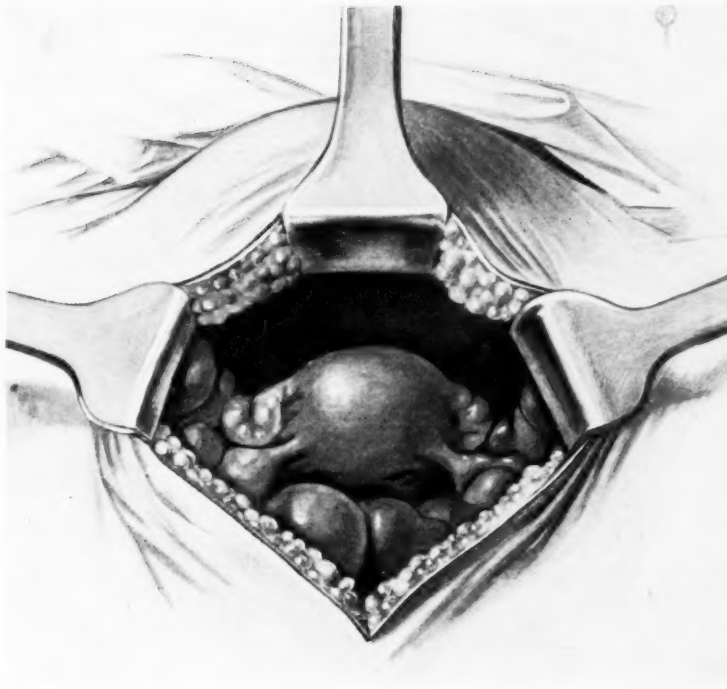
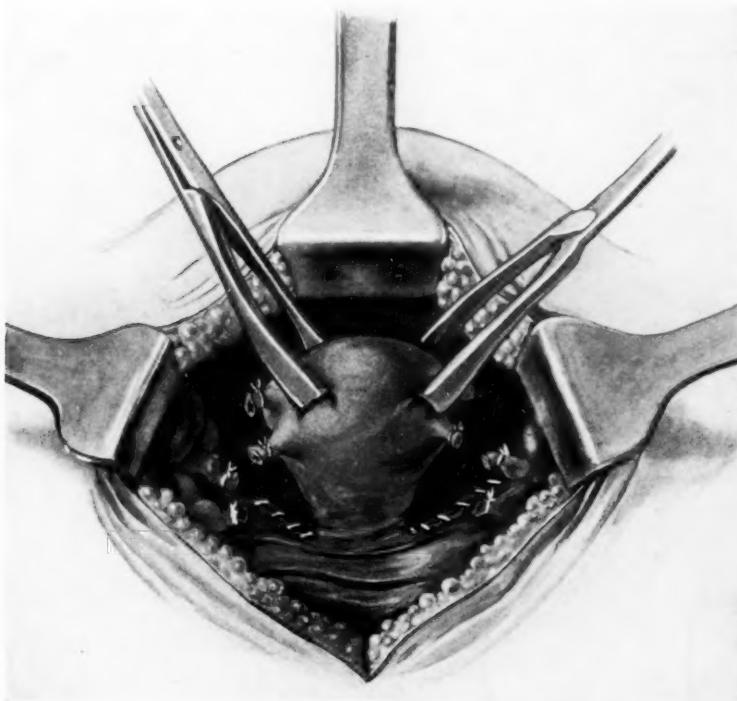FIG. 1.—Exposure of parts to be attacked, through the first median incision.

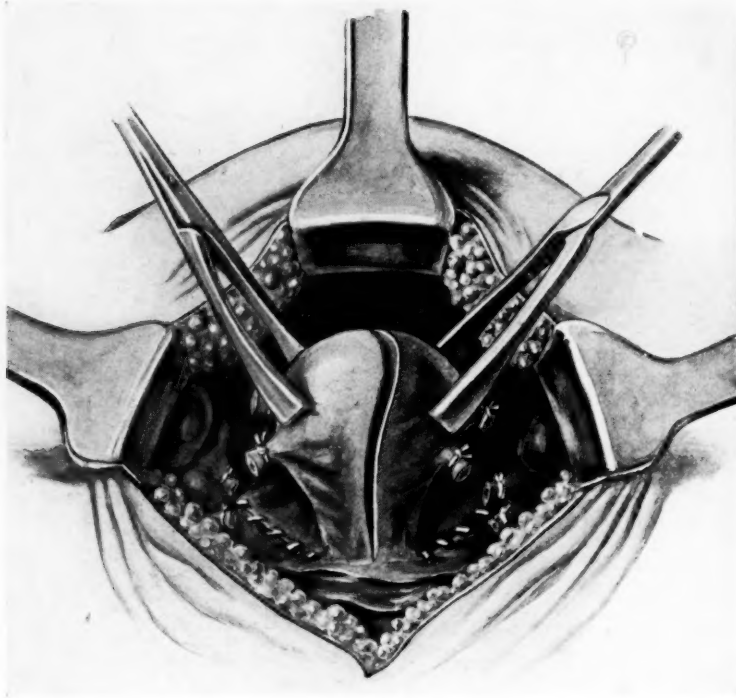FIG. 2.—Showing tubes and ligaments tied off and the sutured peritoneum in place.

FIG. 3.—Uterus split longitudinally downward to the bladder attachment.
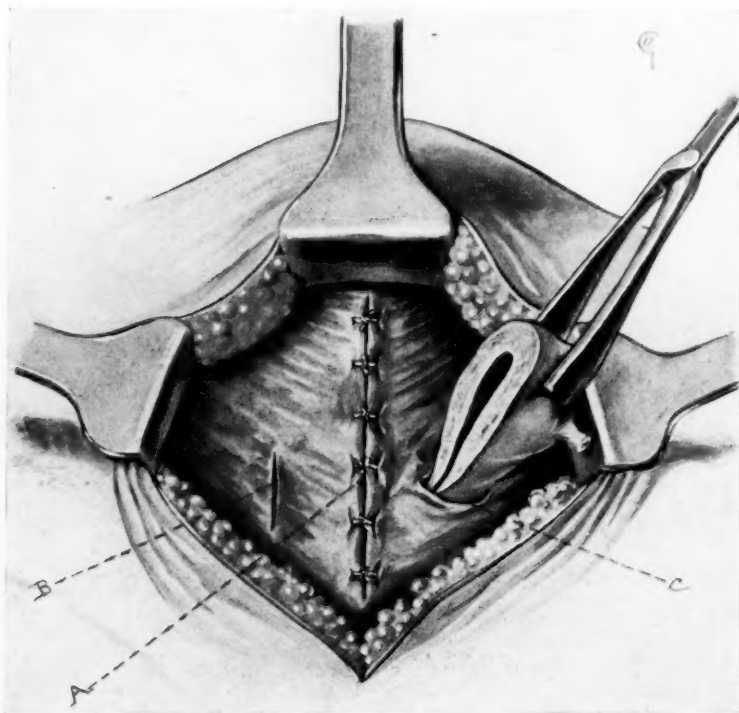

FIG. 4.—A, central incision; B, side incision through the aponeurosis muscle and peritoneum; C, side incision with one segment of the uterus drawn through.
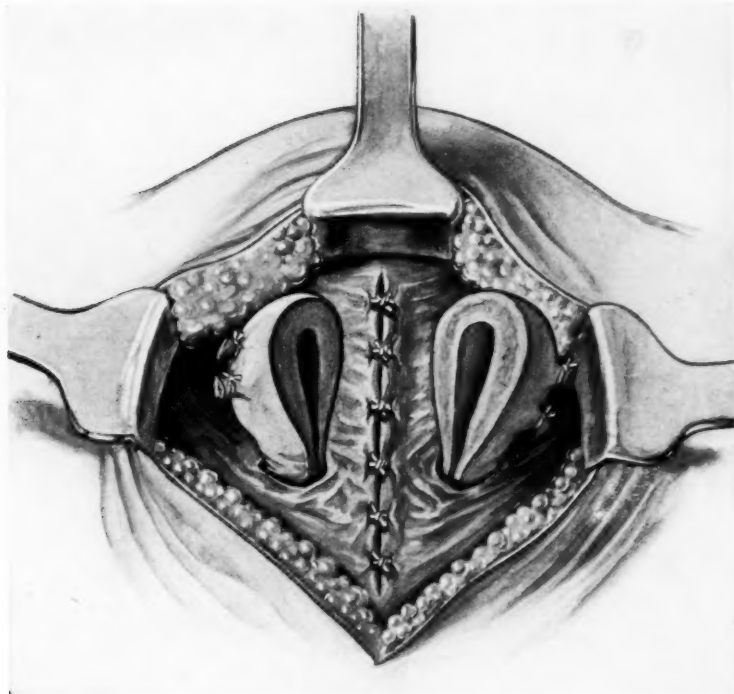
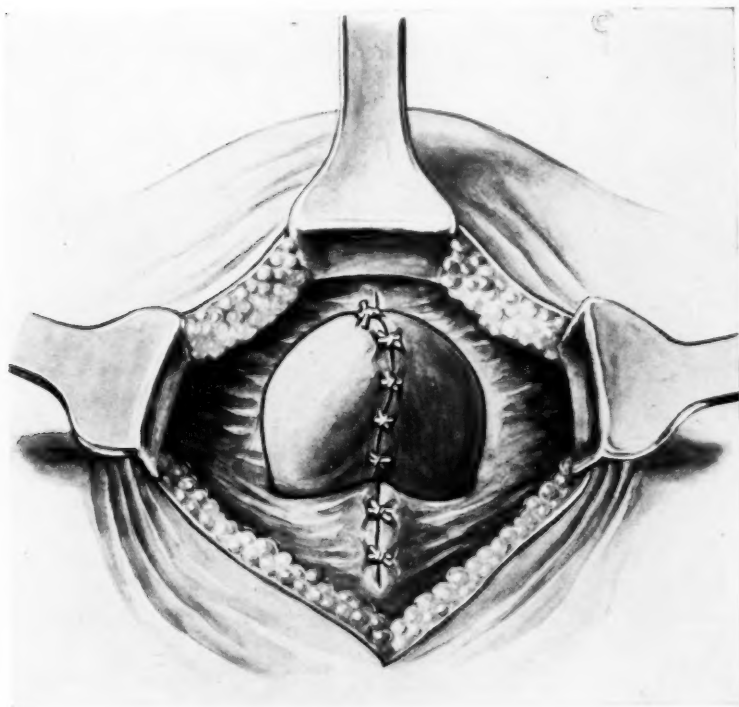FIG. 5.—Both segments of uterus drawn through lateral incisions, and ready to be sutured together.

FIG. 6.—Uterus sewed over the united aponeurosis and muscle.

FIG. 7.—Skin and connective tissue closed over the fundus of the uterus by metal clips.

THE GROSS PATHOLOGY OF MEDIAN BAR FORMATION

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In 1830 G. J. Guthrie, of England, first described median bar formation as a cause of vesical obstruction. His contribution was read before the Royal College of London under title of "Bar at the Neck of the Bladder." During the sixty years that followed the subject received but scant attention from surgeons, with the possible exception of the work of Mercier. For the past two decades this form of obstruction to urination has been studied anew from many points of view, so that we now have a very complete understanding of the character of such obstructive formation. This knowledge includes the clinical symptomatology and diagnosis, the cystoscopic appearance and examination, and the various operative procedures devised for its relief. Again, the tissue removed in the cases of true bar formation by operative means has been subjected to microscopic section as to its minute pathology, so that one might to-day say that the only chapter of median bar formation left unexplored is the gross pathological picture of the condition.

It does seem strange that isolated gross specimens of median bar formation have not been recognized and recorded previously by investigators, either surgeons or pathologists, and I am afraid that it is due to the neglect to investigate these parts routinely at the post-mortem table. There are to my knowledge to-day, after a comprehensive review of the literature, but three illustrations of what we designate as median bar formation; the first by Mercier in 1850, the second by Englisch in 1901—both rough wood cuts—and the third by Watson.

Appreciating that the ideal way would be to trace clinical cases through their post-mortem examination in order to obtain such gross specimens of median bar formation, it was found that the rarity of such opportunities, and the lack of the appreciation of its clinical symptomatology, forbade such a course, and it seemed the wiser procedure to cast aside the detail of the many failures that were bound to occur, and to examine a long series of bladders, urethras, and prostates, as they came to the autopsy table, irrespective of age or clinical diagnosis, hoping thereby to obtain a few specimens in the series which presented the gross changes of median bar formation, trusting to *other* than clinical means to determine the diagnosis, and to have illustrations made of the findings so obtained.

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* Read before the Philadelphia Academy of Surgery, January 8, 1917.

During post-mortem examination of patients, who have died of various diseases in the wards of our large city hospital, there can be frequently observed, in male subjects over forty years, indications of a mild degree of chronic prostatic disease with associated damage to the urinary tract above. It is generally found that no complaint has been made of this by the patient, it is usually unsuspected, unrecorded on the history, and has virtually never received treatment. In these cases, however, one finds at autopsy beginning trabeculation of the bladder, the presence of a slight bas-fond indicative of retention and back pressure, the ureters and renal pelves are dilated to a mild extent, and there is present a recent interstitial nephritis throughout both kidneys, and the renal parenchyma shows indications of pressure atrophy through its substance. When this pathology is viewed by one with a surgically trained mind, it is impossible to avoid the conclusion that the renal destruction, as the result of the partial retention of urine from the prostatic condition, has contributed to a certain extent to the lowering of the patient's power of resistance to a general infection, or has poisoned the heart muscle by the retained products of metabolism which should normally be excreted by the healthy kidneys. These patients succumb to other lethal affections, and their clinical and anatomico-pathological diagnoses rarely take into account the part played by the urinary obstruction, in fact it is the exception if any attention, either at the bedside or the post-mortem table, is directed toward such a diagnosis unless very marked changes are present. Clinically we know that frequently a patient bordering on uræmia and its fatal outcome is born anew to years of useful livelihood by the removal of the obstruction caused by an hypertrophied prostate, and the time is now ripe that *other* forms of vesical obstruction of equal danger should be similarly appreciated and appropriately treated, before the patient, handicapped and poisoned by his own faulty bladder function, succumbs to the first trial his bodily resistance is tested against.

There have now been examined a total of 200 autopsy specimens in this series with ages varying from nineteen to seventy-nine years. Studying them by decades we find that :

From 10 to 20 years there were 3 cases.
From 21 to 30 years there were 21 cases.
From 31 to 40 years there were 37 cases.
From 41 to 50 years there were 51 cases.
From 51 to 60 years there were 42 cases.
From 61 to 70 years there were 33 cases.
From 71 to 80 years there were 9 cases.
From 81 to 90 years there were 0 cases.
And of age unknown there were 4 cases.

It is interesting to note that in this series of 200 cases 46 (23 per cent.) have shown gross pathological changes of one kind or another in either the bladder, the prostate, the posterior urethra, or the seminal vesicles, and the returns from this mode of study have been most lucrative and interesting in all branches of urological pathology.

There have been found 28 specimens of median bar formation, 14 per cent. of the total number of specimens examined showing changes of this type.

Of these 28 median bar cases 8 specimens are recorded as large, by which I mean that there is no doubt that the condition as found must have caused some urinary obstruction and retention, and that the size of the bar and the visible damage to the urinary tract above stood out as a marked abnormality on examination of the specimen. They represent 4 per cent. of the total series and occurred at the ages of forty-six, fifty, fifty-four, fifty-eight, sixty, sixty-seven, and seventy-nine years.

In the remaining 20 cases (10 per cent.), the bar is recorded as small, meaning thereby that though the abnormality was unmistakable on macroscopic examination, the condition was not of so pronounced a degree, nor was it associated with other changes that would make me feel positive that urinary obstruction, of importance or degree sufficient to cause retention, had yet occurred. They are simply the early cases, where development had not reached such a degree as in the previous group. In these the ages are recorded as from twenty-six to seventy-four years. The average age for the cases classified as large bars is 57.7 years and for the small bars 47.5 years, a difference in figures that was to be expected, but not to be considered weighty, except from a clinical and diagnostic standpoint, for with but few omissions they are all within the age when hypertrophy of the prostate may be expected to be the cause of the condition.

In studying these specimens grossly it has been possible to group them into four types which may be described as follows:

1. A type of abrupt bar or dam, rising from, or better stretched across, the posterior lip of the vesical orifice, formed of firm, dense, sclerotic tissue, whose edge is sharp and narrow, and whose lateral terminations form an abrupt angle with the lateral walls of the vesical outlet. In these cases one is apt to find that the so-called urethral trigone—that fan-shaped, striated area, which normally spreads downward from the posterior vesical orifice to converge upon the formation of the verumontanum—has been distinctly shortened, and in marked cases the verumontanum is drawn up directly under the abrupt rise that forms the median bar. This type of bar on cross section is macroscop-

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ically composed of fibrous tissue and is definitely sclerotic from connective tissue proliferation. It is always associated with small, nonhypertrophied lateral prostatic lobes, and has been present in three of the eight cases classified as " large " bar formation.

2. In the second type the bar has an upward tendency of growth, and seems to encroach upon, or draw upon, the vesical trigone more than upon the urethral surface. This type is characterized by an infolding, or creasing, of the vesical trigone transversely, and is the type more readily appreciated cystoscopically by reason of the above characteristic and by the proximity of the ureteral orifices to the vesical outlet. This type has been least frequently found in this series of cases and likewise shows less tendency to obstructive changes. There were found in all three specimens of this type of bar in the entire series. On cross-section it is composed of fibrous tissue similar to that found in Type 1, and has simply expended its efforts in a different direction and is not associated with the urethral shortening so characteristic of the former.

3. In the third type there is formed a bar due to glandular hypertrophy which has its origin in the true median lobe glands, under the sphincter muscle and within the prostatic capsule. This is often the most prominent feature of a beginning general hypertrophy and the early cause of obstruction to the emptying of the bladder. Slight hypertrophy at this point will cause the formation of a thick, broad, roundededged bar of quite different character from that of the other two types, and will cause an obstruction at the orifice, long before a correlative amount of hypertrophy in the lateral lobes assumes any importance whatever. On section there will be found a definite layer of uninvolved tissue three to four millimetres in thickness composed of the mucous and submucous layers, under which will be found definitely hypertrophic glandular tissue occupying the situation of the median lobe acini in the posterior prostatic commissure, with a well-marked encapsulation. This type of obstructive bar is without question the most frequent variety, and seems to be the prevalent location where hypertrophic changes are most apt to start.

4. The fourth type of bar formation is that due to an hypertrophy of the subcervical glands of Albarran [1] alone. These hypertrophies have proven to be quite frequent and rarely develop as a definite bar, but rapidly assume the shape of a perfectly rounded lobe with deep lateral cleftings, and, though often causing marked evidences of

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[1] The simultaneous association of hypertrophic changes in both the posterior commissure and the subcervical glands of Albarran are now under investigation by microscopic study.
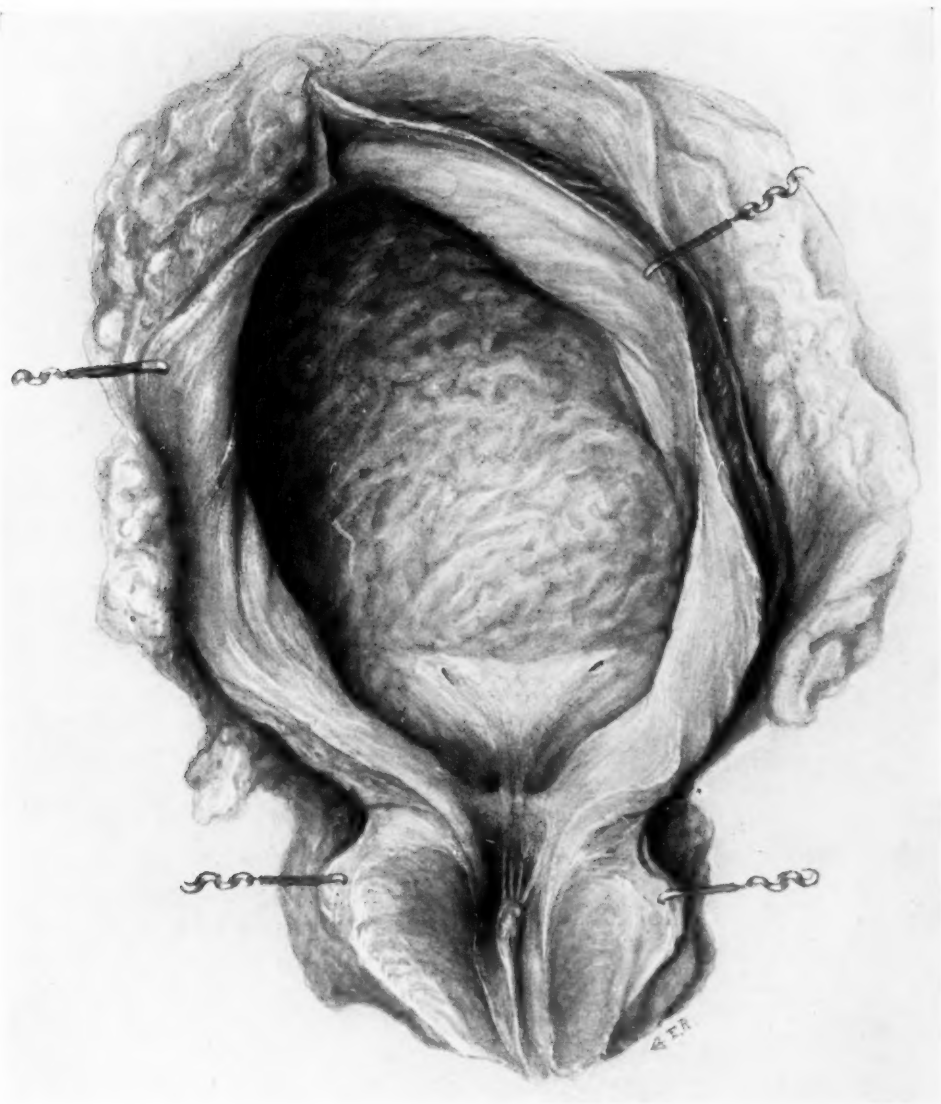
Fig. 1.—Specimen No. 3927. Shows the normal bladder cavity, trigone, vesical orifice, urethra, and prostate of a male, dying at the age of forty-two years, as viewed when opened along the ventral or anterior surface. Note size and relative positions of ureteral orifices, trigone, uvula vesicæ, urethral trigone, verumontanum, and size of prostate. The proportions are drawn to the scale of life size, to which all the following illustrations may be compared, as the same scale has been maintained throughout.
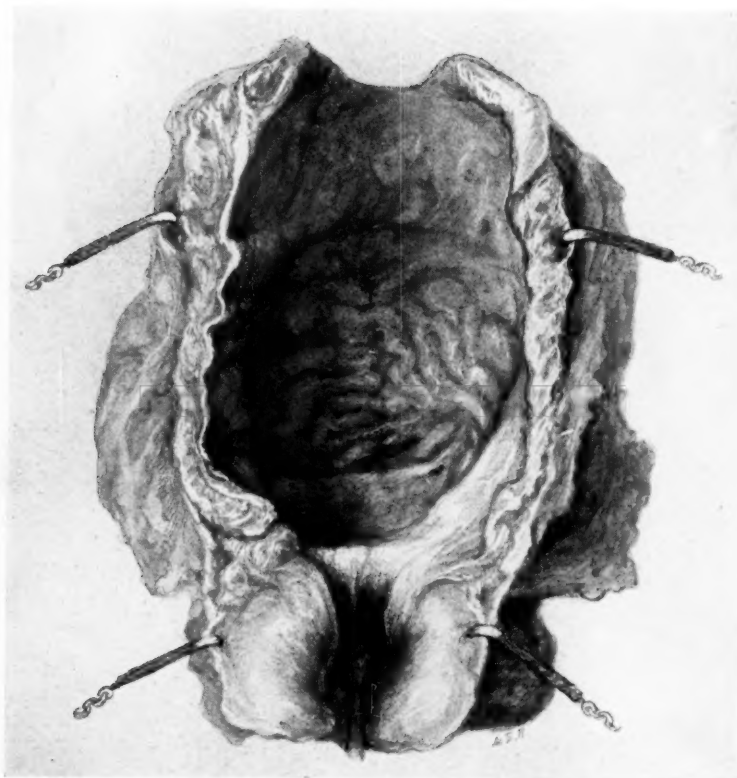
FIG. 2.—Median bar; fibrous; Type 1. Specimen No. 3850. F. H., aged sixty-seven years. Entered the Men's Medical Ward on December 21, 1915. Profoundly toxic, catheterization necessary, urinary output small. Died December 27, 1915. Clinical diagnosis: Lobar pneumonia, chronic myocarditis, chronic nephritis. Anatomical diagnosis: Lobar pneumonia, pleurisy, chronic interstitial nephritis, hypertrophy and dilatation of heart. Specimen shows good bar formation; urethral trigone very much shortened with verumontanum drawn up close under the breast of the median bar. Vesical trigone and prostate normal in outline and size. Note the abrupt angle to the normal course of the urethra where the bar occurs. There was likewise a diverticulum in the vertex of the bladder not shown in this illustration.

FIG. 3.—Median bar; fibrous; Type 1. Specimen No. 3850. Same as Fig. 2, drawn after sagittal section of the specimen, giving in clear detail the position of the bar, character of tissue, location of verumontanum, and abrupt angle to the normal urethral course.
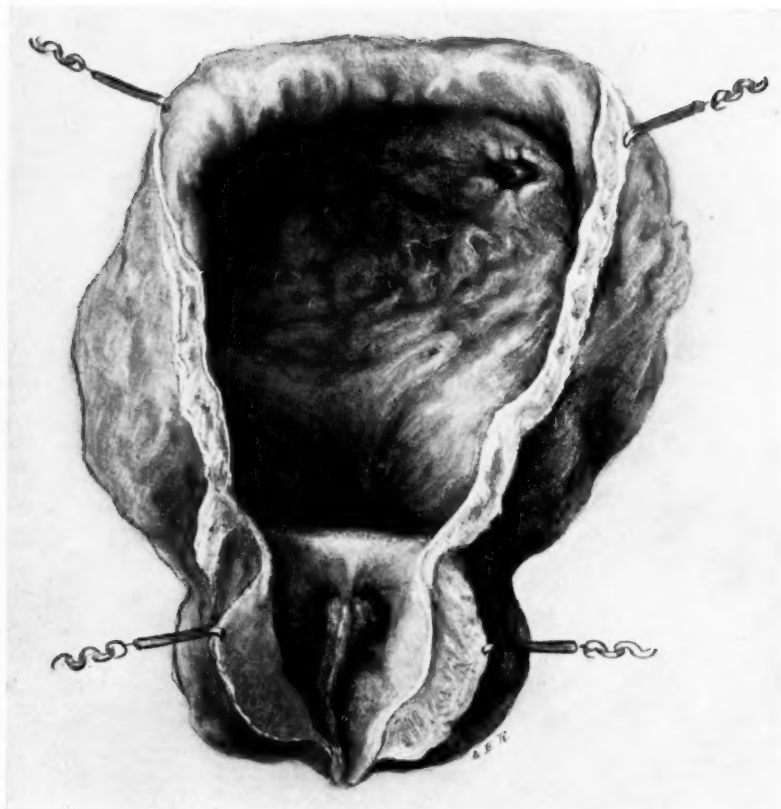
Fig. 4.—Median bar; fibrous; Type 1. Specimen No. 3871. M. G., aged sixty. Entered Medical Ward, January 14, 1916. Suffering with an acute attack of influenza. Died January 20, 1916. Clinical diagnosis: Lobular pneumonia. Anatomical diagnosis: Lobular pneumonia, pleurisy, parenchymatous nephritis, early interstitial nephritis. Specimen shows a thick, short bar, with marked shortening of the urethral trigone, verumontanum being drawn up directly under the base of the median bar formation. Prostate of normal size, vesical trigone of the Y-shaped variety. Evidence of urinary obstruction seen in the formation of the small diverticulum in the vertex of the bladder.
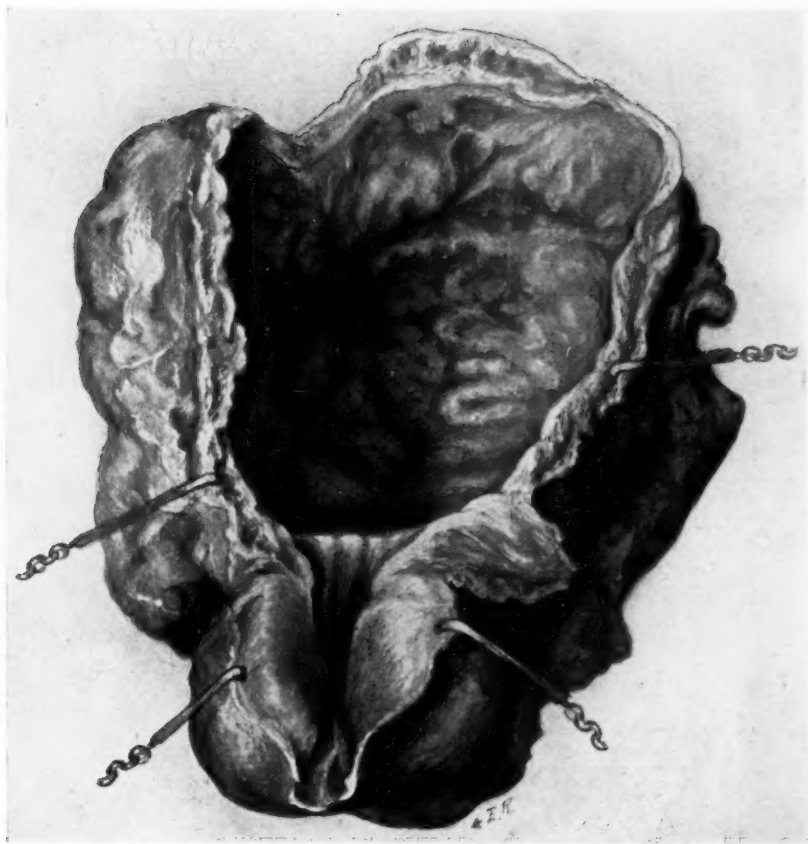
FIG. 5.—Median bar; fibrous; Type 2. Specimen No. 3834. C. T., aged seventy-six. Entered the hospital July 17, 1914. History highly suggestive cf carcinoma of the œsophagus, and after a protracted confinement the patient died December 10, 1915. Clinical diagnosis: Carcinoma of the œsophagus, chronic myocarditis, arteriosclerosis. Anatomical diagnosis: Carcinoma of the œsophagus, stomach, and liver; chronic diffuse nephritis. Specimen a good illustration of bar formation and of the second type which is characterized by encroachment on the vesical trigone, with shortening and transverse creasing of it, rather than on the urethral surface. There is a well-marked bas-fond and beginning trabeculation and thinning in the bladder walls. No prostatic enlargement.
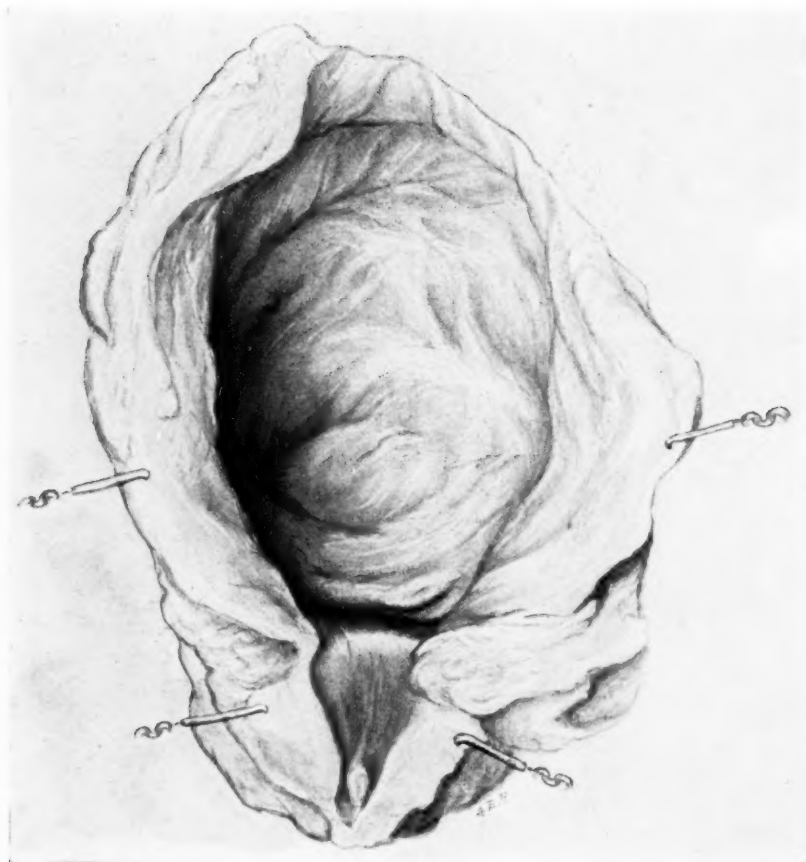
FIG. 6.—Median bar; fibrous; Type 2. Specimen No. 3959. A. F., aged fifty-five. Entered Tuberculous Ward December 21, 1915. History gives no note on any genito-urinary complaint. Died March 30, 1916. Clinical diagnosis: Pulmonary tuberculosis. Anatomical diagnosis: Ulcerative and conglomerative pulmonary tuberculosis, chronic parenchymatous nephritis, slight dilatation of right ureter. Specimen shows the second variety of bar where the encroachment is upward and upon the vesical trigone. The urethral surface is but little if any shortened, but the bar is definitely present and there is a deep transverse clefting or creasing of the vesical trigone that brings the ureteral orifices in close approximation to the vesical orifice. The bladder wall is as yet undamaged except for the presence of a decided bas-fond.

FIG. 7.—Median bar; glandular; Type 3. Specimen No. 4123. G. F. H., aged fifty-six. Entered the Men's Medical Ward May 17, 1916, complaining of shortness of breath and general cardiac symptoms of eighteen months' duration. History of a specific urethritis in youth. Physical examination reveals general symptoms of broken compensation and Cheyne-Stokes respiration. History notes urinary output as small, urine examination shows low specific gravity, trace of albumin, and a few hyaline casts. Patient died October 1, 1916. Clinical diagnosis: Myocarditis, decompensation, chronic interstitial nephritis. Anatomical diagnosis: General anasarca, dilatation of heart, chronic fibroid myocarditis, multiple pulmonary infarcts, chronic diffuse nephritis. The specimen is one of glandular bar formation due to hypertrophic glandular changes in the posterior prostatic commissure. The bar is thick, rounded, and firm. The bar has an upward tendency of growth causing, as is characteristic of Type 2, a transverse creasing of the vesical trigone: however, grossly, it in no wise resembles a fibrous type of bar. The lateral prostatic lobes are slightly enlarged. The bladder wall decidedly hypertrophied.

Fig. 8.—Median bar; glandular; Type 3. Specimen No. 4071. W. I. L., aged twenty-six. Entered the Medical Ward July 14, 1916, with acute pulmonary symptoms. He gave a history of having had a Neisserian infection fifteen years ago. There are no genito-urinary symptoms recorded on the history. He died a typical pulmonary death July 16, 1916. Clinical diagnosis: Lobar pneumonia. Anatomical diagnosis: Lobar pneumonia, cloudy swelling of kidneys. The specimen shows a small bladder with thick (hypertrophied) walls. There is a definite bar at the vesical orifice of the thick glandular type. The hypertrophy of the bladder musculature has been in an effort to overcome the beginning obstruction, and helped by youth the compensation has apparently been complete to the time of death. Section of the bar in the midline demonstrated an increase in the prostatic glandular tissue of the posterior commissure, early hypertrophy at this point having been responsible for the bar formation.
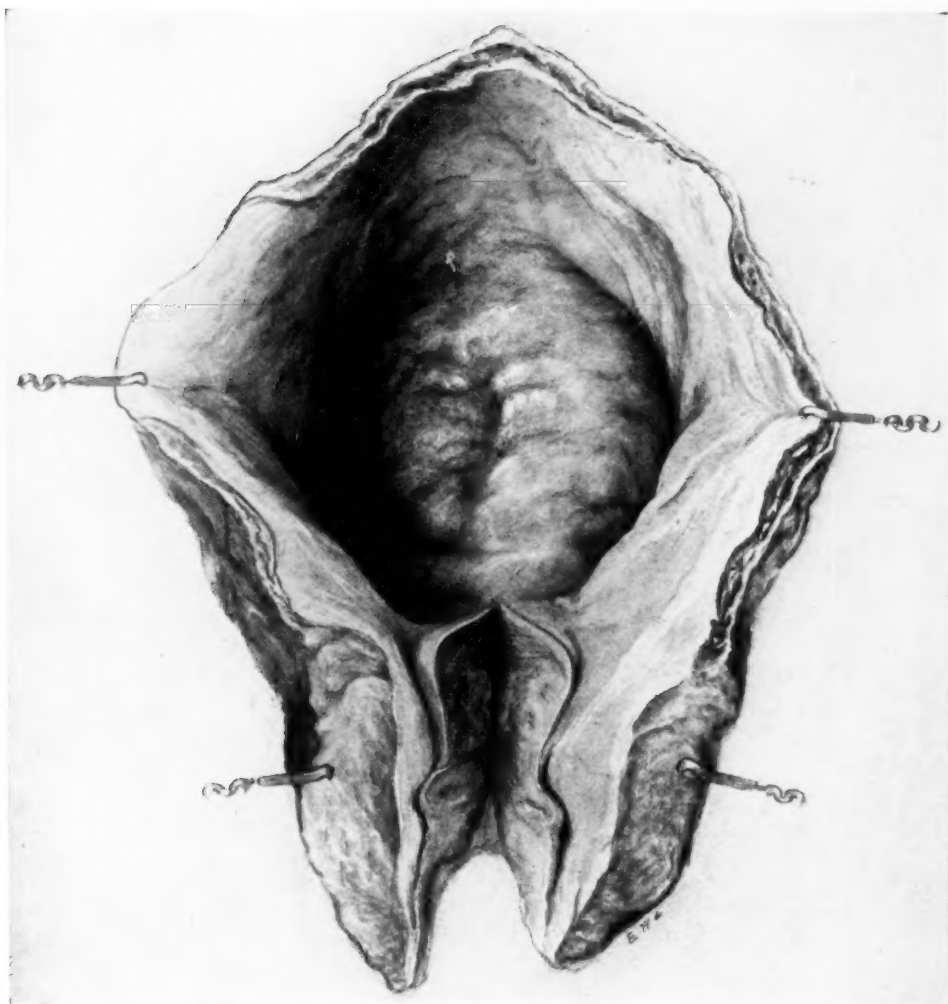
FIG. 9.—Median bar; glandular; Type 3. Specimen No. 4030. F. K. B., aged fifty. Entered the Neuro-logical Ward, May 30, 1916, complaining of pains in his legs and head, and an unsteady gait. Only genito-urinary note in the history is the occurrence of a specific urethritis six years previously. Patient died in an apoplectic stroke on June 9, 1916. Clinical diagnosis: Cerebral hemorrhage. Anatomical diagnosis: Intracra-nial tumor, bronchopneumonia, cloudy swelling of kidneys. Specimen is one of the thick median bars which has been incised in the midline to again demonstrate the hypertrophic glandular tissue in the posterior prostatic commissure as the cause of the bar formation. There is a very slight amount of lateral hypertrophy, and the bladder wall is beginning to give way and to dilate its walls being considerably thinned

Fig. 10.—Median bar; glandular; Type 4. Specimen No. 3963. G. S., aged fifty. Entered the Insane Wards, February 2, 1916. He had been picked up on the street by the police, gave evidences of having lived a tramp's life, could give no coherent statement as to his past and lacked any knowledge of the present. His history notes general lessening of mental faculties, restlessness, senility, and dementia. He is incontinent. Wassermann is negative. Died March 30, 1916. Clinical diagnosis: Senile dementia, arteriosclerosis, dry gangrene of right foot. Anatomical diagnosis: Bronchopneumonia, chronic interstitial nephritis, obliterative arteritis of right posterior tibial artery. Specimen shows a small nodular hypertrophy at the vesical orifice. Behind this is a highly trabeculated bladder wall giving all the necessary evidence of having worked against a gradually increasing degree of obstruction. This nodular hypertrophy is situated just under the mucous membrane, is not associated with any hypertrophy of the prostatic lobes, nor was there any stricture of the urethra present. This type of obstruction is due to an isolated hypertrophy of the subcervical group of glands of Albarran.

FIG. 11.—Median bar; glandular; Type 4. Specimen No. 3824. H. A. R., aged fifty-four. Entered the Genito-urinary Ward, November 27, 1915, in a semiconscious condition. Incontinence of urine. A very large hydrocele was aspirated on December 1, 1915, and the patient transferred to the Neurological Department with the diagnosis of gumma of the brain. Wassermann positive. Died December 3, 1915. Clinical diagnosis: Cerebrospinal lues, chronic interstitial nephritis. Anatomical diagnosis: Multiple gummata of the brain, œdema of the lungs, chronic diffuse nephritis. Specimen shows in the gross a slight median bar formation which mesial section demonstrates to be due to a small cluster of gland acini, visible to the naked eye, situated immediately in the edge of the bar. The bar in this case was so small that not until sectioned and the above noted, was it considered worthy of preservation. It is undoubtedly a very early hypertrophy of the subcervical glands of Albarran, further enlargement of which produces the isolated median lobe hypertrophies.
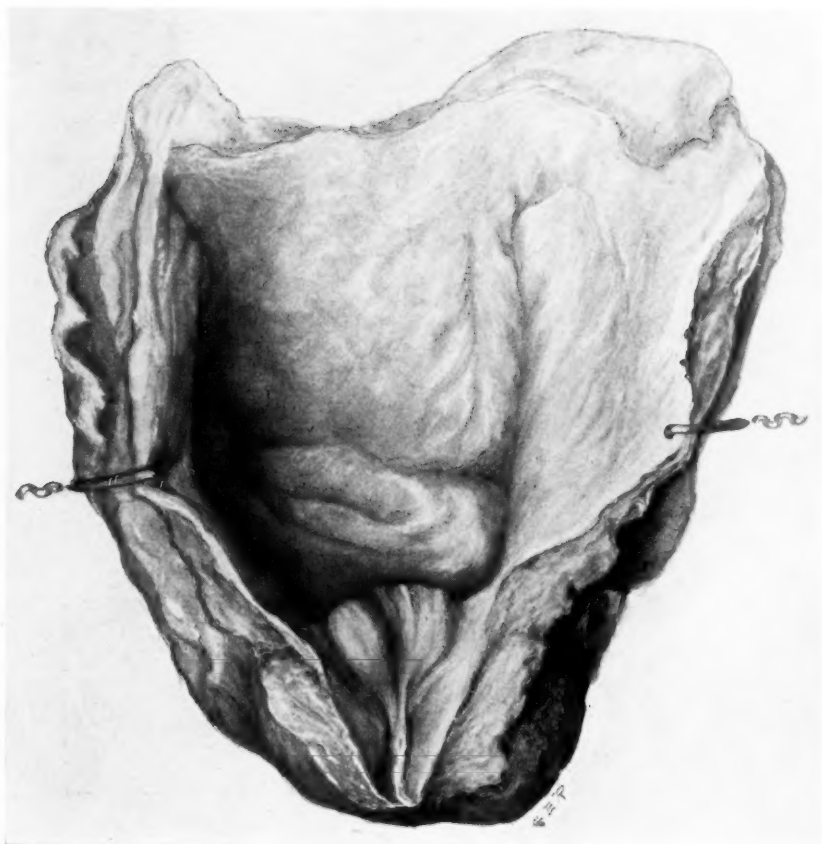
Fig. 12.—Median bar; glandular; Type 4. Specimen No. 3967. A. B., aged sixty-seven. Entered the Medical Ward, March 20, 1916, complaining of abdominal pain, dizziness, and paralysis of right leg. Patient found to be very weak, pain in abdomen of five days' duration and of shooting character. Inability to use right leg of four days' duration and gradually increasing in its extent. No venereal history. Patient very emaciated, semicomatose, incontinence of urine and fæces. Heart sounds weak, chest negative, abdomen rigid, but with no localizing tenderness. He became progressively weaker and right-sided hemiplegia developed, and he died March 31, 1916. Clinical diagnosis: Cerebral thrombosis. Anatomical diagnosis: Bronchopneumonia, chronic fibrous pleurisy, chronic interstitial myocarditis, chronic valvulitis, arteriosclerosis, chronic interstitial nephritis. Specimen shows a lobular median obstruction with deep lateral cleftings. It is superficial and covered only by the mucous membrane. Bas-fond well developed, bladder walls hypertrophied, prostate normal in size. Like the two preceding specimens it represents an isolated hypertrophy of the subcervical glands of Albarran.

urinary obstruction, even when quite small, are seldom in the class of true bar formation. Several beautiful specimens of such isolated hypertrophies have been encountered in this series, and it has been a matter of difficulty to decide whether to group them with the bar cases where clinically they belong, or under prostatic hypertrophy which anatomically they are.

Clinically both these types of glandular hypertrophies cause urinary obstruction, and the size will often obliterate the anatomical origin. Moderate-sized enlargements form a borderline group where personal opinion alone can be used in deciding the anatomical origin as between the glandular bar and the solitary hypertrophied subcervical glands.

If one bears in mind the close similarity of the symptomatology of all vesical neck obstructions and the four types here differentiated, one can then readily appreciate that first of all (a) the surgical treatment must of necessity be different as between the median bar formation and generalized prostatic hypertrophy; (b) that, second, the mode of treating the various types of bars will differ according to the variety present; (c) and, third, that the differential diagnosis in the living must depend entirely upon an accurate cystoscopic study of the vesical orifice.

HÆMANGIOMA CAVERNOSUM OF BONE*

By James M. Hitzrot, M.D.

of New York City

HÆMANGIOMA cavernosum or cavernoma as a bone tumor is sufficiently rare to warrant the publication of the following case, which, in so far as can be discovered from the literature, is the only case of this type located in the upper end of the humerus so far reported, and the only X-ray picture of this lesion in existence in so far as I know.

C. R. M., physician, aged twenty-five, consulted me in January, 1916, for pain he was having in the right shoulder with some swelling about the shoulder-joint. He dates his present illness to an injury received six years ago while playing basket ball. The injury was accompanied by pain in the shoulder, dull aching in character, with tenderness over the head of the humerus and inability to use the shoulder-joint. This pain, etc., persisted for four months and finally disappeared with treatment by baking and by salicylates internally.

Four years later, two years ago, the pain reappeared in the shoulder after some unusual exertion and at this time the pain was chiefly evident upon attempts to use the arm. Following this attack there was crepitus in the joint. This second attack was also relieved by baking and salicylates. X-ray plates taken at this time were said to show nothing abnormal.

Off and on since then the patient has suffered from slight pain in the shoulder-joint following active use of that joint, and this pain was always relieved by salicylates. Four weeks before consulting me he began to suffer from severe pain in the right shoulder accompanied by inability to abduct the arm, except with care and then only partially. With these attempted movements, shooting pains caused the patient to stop. There was distinct tenderness over the head of the humerus, and at this time he thought there was a perceptible enlargement in the region of the right deltoid.

His past history showed measles, scarlet fever, whooping cough, diphtheria. Three and a half years ago he had typhoid fever with extensive phlebitis including both axillary veins. At

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this time he also had thrombosis of a number of cutaneous vessels in the shoulder region. No venereal history.

His family history contained only one interesting fact, his father had a bony tumor removed from his right humerus near the shoulder at fourteen. This tumor was said to have been bony with a blood clot in it. So far as his father knew there was no microscopical report.

The examination was negative, except for the right shoulder region. The right deltoid was more prominent and the whole deltoid region seemed to bulge more than the opposite. There was tenderness over the upper end of the humerus not definitely localizable to any one spot, but more or less diffuse over the whole region of the head. The whole upper end of the right humerus seemed larger than its opposite and there was an irregular mass, hard in character, attached to the upper end of the bone. There was distinct crepitation in the joint and pain in the joint when the arm was abducted against resistance.

An X-ray picture showed a tumor mass composed of a bony shell with bony trabeculæ dividing it into numerous cyst-like compartments which occupied the upper end of the humerus from the head well down to the deltoid attachment. The tumor seemed to spring from the outer surface of the bone, and except for the intertrochanteric region, did not seem to involve the shaft.

The preoperative diagnosis was a tumor of bone, possibly a myxochondrosarcoma, or some form of bone cyst possibly of typhoid origin.

On January 11 I operated upon the shoulder through a six-inch incision over the anterior aspect of the deltoid muscle extending from the clavicle to below the attachment of the deltoid muscle. The anterior fibres of the deltoid muscle were split, and in doing this, the anterior branch of the circumflex nerve was divided and the two ends were caught and retracted, exposing the swelling which extended from the attachment of the deltoid muscle upward along the bicipital groove to the region of the top of the great trochanter, and then bulged outward on the outer aspect of the bone under the muscle. The muscle tissues were carefully reflected away from the outer edge of the bicipital groove and with a sharp osteotome the whole swelling was cut away from the underlying cortical bone. When this swelling, which was covered by a thin shell of bone, was opened, about one and a half ounces of straw-colored, slightly mucoid fluid escaped. This bony shell, which was lined by a mass of coagulated slightly altered blood, was then turned back exposing the shaft of the bone. In the region of the epiphysial line there was

a small opening in the bone filled with altered blood clot. The tumor was then chiseled away from the shaft of the humerus and from the greater tuberosity and from its attachment to the head, and removed in practically one piece with the underlying periosteum. The cavity in the head was then scraped thoroughly with a stout curette, and a small sequestrum surrounded by altered blood clot was removed. The surrounding shaft of the bone and the greater tuberosity presented a slightly eroded appearance, but was otherwise practically normal. The cavity in the head was then widened, so that it presented a perfectly flat surface, and a piece of the deltoid was cut away from the anterior surface of the muscle, leaving the superior part attached to the clavicle, and this muscle flap was then placed in the cavity to fill it, and sutured there by stitches passed through its upper surface. The remainder of the wound was closed with plain catgut, using running horse-hair stitches in the skin. A small rubber tissue drain was placed down to the region of the bone cavity from the top of the transplanted flap of the deltoid.

The operative diagnosis most likely seemed to be some form of bone cyst resulting from his typhoid. The pathological report by Dr. Elser gave the correct diagnosis.

Pathological Report (Dr. Elser).—Cavernoma of bone. Specimen consists of a shell of bone removed from the outer face of the head of the humerus. It measures about 8 by 4 cm., presents a relatively smooth outer surface, with low trabeculæ projecting from the inner surface. The interval between this shell and the bone proper was filled with bloody material. The face of the bone proper, forming the inner wall of the cavity, showed a small circular depression filled with what appeared to be necrotic material.

Microscopic examination of this material shows the picture of an organizing blood clot. In a few areas the cells are rather atypical, arousing the suspicion of a sarcomatous transformation. Other sections show the appearance of a cavernoma. Considering all the factors in this case we are led to regard it as one of cavernoma in bone, with organization of extravasated blood.

It is probable that the angiomata so far reported represent three distinct types of tumor formation:

1. The cavernomata which are solitary and are represented by the tumor in the case reported in this paper, and by the cases of Virchow, Toynbee, Schuh, Verneuil, Schöne, Travers, Gerhardt, Muthmann, Ehrmann, Zajaczkowski, Neuwerk, Birch-Hirshfield, Kauffmann, Stanley, Moltrecht, Lucke, Peau, and Robin, etc.

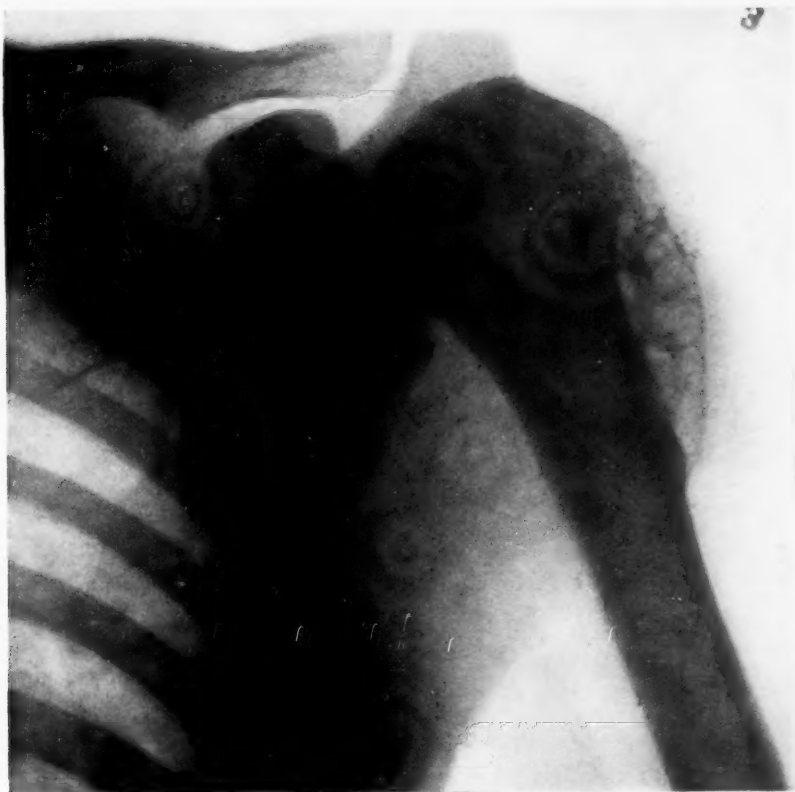2. The angiomata which are multiple and involve the bone and
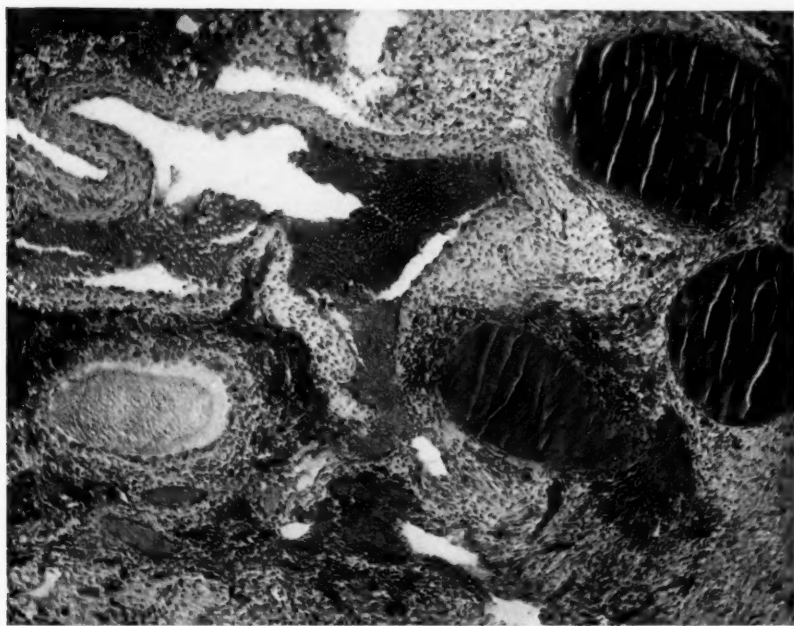
FIG. 1.—X-ray of tumor.

FIG. 2.—Low power view of the angiomatous tissue. Note the large vascular spaces. In the lower portion of the picture is seen the blood clot in varying stages of organization.

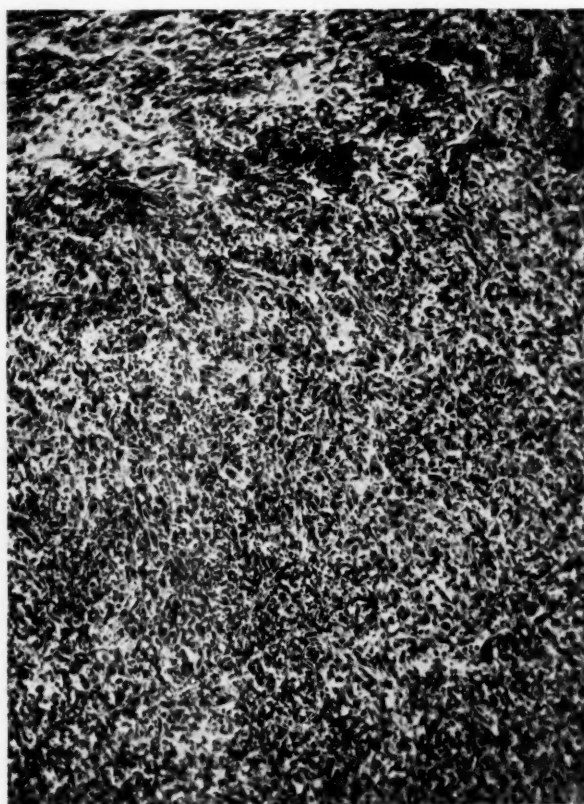FIG. 3.—High power view of the same field to show the character of the walls of the vascular spaces.

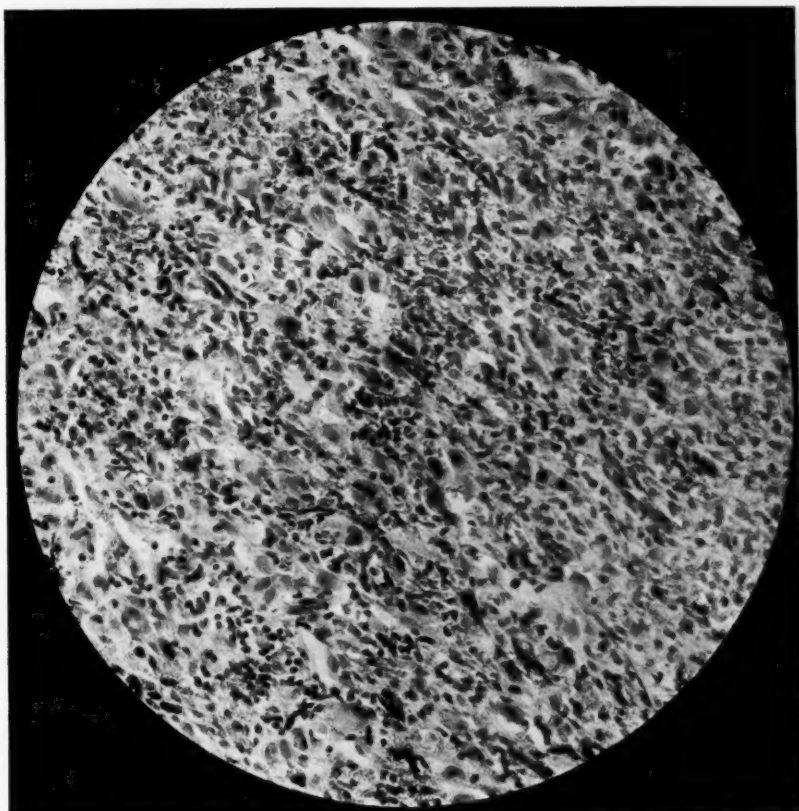FIG. 4.—Low power view of the organizing blood clot shown in Fig. 2.

FIG. 5.—High power view of a section of Fig. 3, to show the large mononuclear cells with deeply staining nuclei which aroused Dr. Elser's suspicions as to the character of the tumor. (See Dr. Elser's report for other details.)

the viscera, represented by the cases of Virchow, angioma of the vertebra with cavernoma of the liver, by Cruveilhier's both cases, and in the case described by Saltykow. The cases in this second group differ in their extreme vascularity and in the multiplicity of the lesions from that described in the first group.

3. By that unusual case reported by Symmers as multiple primary hæmangio-endotheliomata of the osseous system.

The angiomata in the bone originate in close relationship to the epiphysial line or to the centre of ossification or near the fissures in the skull. It is difficult to distinguish from the descriptions in the literature which tumors are of periosteal and which are of central origin, but the latter type predominates. One may accept as periosteal the tumors in the skull observed by Virchow and Toynbee. Those of central origin are the ones described by Schuh, Verneuil, Travers, Gerhardt, Muthmann, Ehrmann, Zajaczkowski, Schöne. The case here described was evidently of central origin arising near the epiphysial line about midway between the tuberosities.

The histological picture is quite variable, ranging from richly vascular tissue to poorly vascular cyst-like tumors with large spaces filled with organizing blood clot which may show areas of ossification.

The tumor here described did not in its gross appearance differ materially from some of the described forms of bone cyst, especially those containing blood clot. The thorough histological investigation of the wall of the cavity by Dr. Elser determined the diagnosis which could not have been made otherwise, and would have been missed entirely if only a portion of the tumor mass had been examined, for some sections merely showed organizing blood clot with a cellular picture rather difficult to distinguish from a possible sarcoma, while the true angiomatous tissue lay close to the outer shell of bone and the bony trabeculæ (see microphotographs).

The clinical picture is likewise variable. As a rule the tumor grows slowly, producing symptoms especially in the vertebra and skull by pressure upon the surrounding structures, does not pulsate except in rare cases and then only when it has broken through the bony shell. These tumors as a rule are single and show no tendency to metastasize, and in the cases thoroughly removed do not recur locally.

The single predominant feature of the case here described was pain which occurred in recurring attacks and up to the last attack was relieved by salicylates and baking. The enlargement of the deltoid, the doctor thought, occurred only with the last attack. It is difficult to understand the disappearance of this pain under the treatment

above given, and it would be extremely valuable could we have seen the X-ray plates taken during the attack two years ago. Unfortunately they were not to be found.

The clinical diagnosis is, as a rule, difficult if not impossible. In so far as I know, my case is the only one in which there was an X-ray picture of the tumor. There is nothing in the picture which would suggest the diagnosis. In fact, one could not say from the X-ray picture alone what the tumor might be. Comparison of a number of such pictures and a careful study of a group of these cases may show diagnostic radiographic evidence which is not now possible.

Schöne believes that the bleeding which occurs at the operation will help in making a diagnosis. In my case there was no more bleeding than would occur in any operation upon bone near the epiphysial line, and there was nothing in the gross appearance except the large cyst-like spaces filled with blood clot in various shapes of organization which would suggest the tumor. It is possible that one may find these tumors in three different types or stages, i.e., (1) when they are richly vascular and will bleed freely at operation, for example the cases of Peau and Moltrecht; (2) when they show large cyst-like spaces filled with organizing blood clot, as in my case; and (3) when they may show various stages of ossification as shown in Lucke's case and which Von Recklinghausen called an ossifying angioma, or angiomatous osteoma.

The diagnosis must eventually rest upon the microscopic picture of the tumor. In the case here described the pictures from various fields showed distinct differences, and had only that portion of the tumor which showed organizing tissue alone been studied, the real condition might readily have been overlooked.

The literature is replete with vascular tumors in bone. The probable cases of angioma classified according to the bone involved are: Femur—Nauwerk, Schleich; metacarpals and phalanges—Schuh, Birch-Hirshfield; clavicle—Travers; pelvis—Cruveilhier; vertebra—Virchow, Gerhardt, Muthmann, Saltykow, Kauffmann; tarsal scaphoid—Verneuil; bones of the skull, lower jaw—Stanley, Moltrecht; upper jaw—Lücke, Peau, Robin; skull, parietal bone—Virchow, Toynbee, Ehrmann, Rokitansky; occipital bone—Cruveilhier, Zajaczkowski, Schöne (who mentions articles by Djaknow and Callozi to which he did not have access). Ziegler mentions a microscopic section of an angioma from the skull but gives no details.

About a month after the case was shown (April 15, 1916), following some strenuous efforts at tennis, the shoulder again

became painful and motion became distinctly restricted. An X-ray picture at this time showed a nodular growth toward the inner aspect of the head which looked like exostoses or recurrences of the tumor growth.

On April 17th the joint was reoperated upon and a mass of exostoses found along the bicipital groove. These were removed and at Dr. Elser's suggestion pieces of bone and overlying soft tissue in the region of the previous growth were removed for microscopical examination. There was no evidence of recurrence at the operation and the condition found was regarded as inflammatory exostoses due to the trauma of the previous operation or to the stretching of the scar tissue by the exercise in question.

Dr. Elser's report of the tissue removed at the second operation, April 17, 1916:

The specimen consists of several pieces of bony and soft tissue removed from the upper end of the humerus. The material is divided into two portions, A and B. A, two pieces of soft tissue from the seat of the original growth and a portion of the bony wall from the same location. B, two pieces of osteophytes arising from the opposite side of the bone. The material consists of material removed from the cavity in the head of the humerus at the previous operation, and of portions of the exostoses projecting from the head of the bone on each side of the groove of the biceps tendon.

Microscopic examination of the bony structures shows them to consist of cancellous bone. Microscopic examination of tissues from the cavity referred to above shows connective tissue with islands of round-cell infiltration surrounding foreign body giant-cells, and scattered here and there, cells containing blood pigment. No evidences of a tumor process could be found. Diagnosis: Exostosis of the head of the humerus.

His subsequent history is uneventful. There are still exostoses forming in the region of the bicipital groove which I believe account for the little residual pain which occurs after violent exercise.

X-ray plates made at frequent intervals have shown no recurrence of the tumor.

LITERATURE

Birch-Hirshfield: Lehrbuch d. Path. Anat., 1887.

Cruveilhier: Traité d'Anatomie Path. Gén., Paris, 1856–62, i, iii, iv; Anat. Path. d. Corps Humaine, Paris, 1835–42, liv, 33.

Cruveilhier: Loc. cit.

Ehrmann: Musée de la Faculté de Méd. de Strasbourg, 1877, 1 Nr. iii (Schöne).

31   481

Gerhardt: Zeitschr. f. Nervenheilkunde, Bd. vi.
Kauffmann: Spec. path. Anat., 6 Auflag., Berlin, 1911, p. 749.
Lücke: Deutsch. Zeitschr. f. Chir. 30.
Moltrecht: Osteoaneurysma. Inaug. Diss., Jena, 1869.
Muthmann: Virchow's Archiv, 172.
Nauwerk: Virchow's Archiv, Bd. iii.
Peau: Gaz. des Hôpitaux, 1896, p. 223.
Robin: Phila. Med. Times, 1874.
Rokitansky: Lehrbuch d. Path. Anat., 1856, Aufl. iii, 7, Bd. ii, p. 130.
Saltykow: Centralb. f. Allg. Path., No. 20, p. 511.
Schleich: Deutsch. Med. Woch., 1891, No. 48, p. 1315.
Schöne: Zeigler. Beitr. f. Path. Anat. Suppl. 7, 1905, p. 685-701.
Schuh: Wiener. Med. Halle., 1862, p. 107.
Stanley: A Treat. on Diseases of the Bones, London, 1849.
Symmers and Vance: Amer. Jour. of Med. Sciences, July, 1916, No. 1, vol. clii, p. 28.
Toynbee: 1845, 1847.
Travers: Medico-Chir. Trans., 1838, vol. xxi.
Virchow: Geschwulste, Bd. iii.
Virchow: *Loc. cit.*
Verneuil: Tumeur, Sanguine, Siégent dans l'Os Schapoid du Torse. Bull. de la Société Anat. Path., 1847.
Zajaczkowski: Centralb. f. Chir., 1901.
Ziegler: Lehrb. d. Path. Anat., 1905, p. 424.

CHRONIC MEDULLARY ABSCESS OF THE LONG BONES

ITS CLINICAL AND RÖNTGENOGRAPHIC FEATURES: ITS TREATMENT BY SIMPLE TREPHINING

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A SEARCH of the literature in English, German and French, including the standard works on general pathology, surgical pathology and surgery, revealed but few references to any type of chronic bone abscess (excluding the suppurative process associated with bone necrosis) other than that of the bone substance itself (cancella), generally known as " Brodie's abscess." Very few of the authors indicate—and some of them only vaguely—that there also may occur a chronic accumulation of pus, large or small, wholly within the medullary cavity. Indeed, Bowlby[1] says: " Chronic abscess is never met with in the shafts, but always in the cancellous tissue of the epiphysial ends." This statement is quite incorrect, not only because it denies the occurrence of medullary abscesses, but also because the so-called Brodie's abscess (" epiphysial abscess," Cruveilhier), although most often located in or near an epiphysis, is also sometimes found in the shaft.

In contrast with Bowlby's utterance it is only fair to quote here the clearest anatomical description of chronic medullary bone abscess that I have succeeded in finding: " There is a form of osteomyelitis . . . which is fairly entitled to the term chronic, although in its main characteristics it presents the same pathological features as the acute form. . . . It also differs from the acute form in that it is associated with a chronic ostitis of the compact bone, and an osteoplastic periostitis which leads sometimes to a very considerable thickening of the shaft of the bone over a greater or less area and occasionally to a considerable increase in length. Sometimes there occurs an accumulation of pus, which may vary from a few drops to several ounces. This pus may be confined to the region of the medulla, or it may form a distinctly circumscribed abscess in or near the epiphysis of the bone. The latter is the commonest form, and such abscesses are frequently known as Brodie's abscess." [2] It is not clear whether Mumford[3] also meant to describe a medullary pus accumulation, or an extensive abscess of the bone substance itself, in the following: " Chronic localized

bone abscesses develop variously. They may be small or may occupy nearly all the shaft of the long bone. They cause no definite sequestrum."

Brodie's abscess, the chronic circumscribed abscess of the bone substance, is readily recognized in the röntgenogram as a translucent area surrounded by the shadow of dense bone (Fig. 1). In the region of the abscess this productive ostitis may cause much thickening of the bone, and often associated with it is a localized periostitis.

The medullary abscess, like acute suppuration of the bone marrow, cannot be recognized as such, röntgenographically. The röntgen ray appearance is that of an osteoperiostitis (Fig. 2) or of a bone that has been the seat of an osteomyelitis (Fig. 4). Although the diagnosis therefore cannot be made by the röntgenographer, it can be made by combining his findings with the clinical observations. Perhaps, however, a suggestion for a röntgen ray diagnosis can be found in the character of the ostitis as it appears in the picture: when the abscess is medullary there is sometimes but little external thickening of the bone; the ostitis then spreads centripetally, encroaching upon and sometimes in one or more places completely obliterating the medullary cavity (Fig. 2). This internal thickening is by dense dry bone. Such an ostitis or osteoperiostitis, when, by its appearance or otherwise, syphilis can be excluded, and when there is no evidence of necrosis or cortical abscess, would justify the röntgenographer in suggesting the possibility of pus in the marrow cavity.

The chronic medullary abscess of a long bone, uncomplicated by any active process, is not associated with fever, as far as my experience indicates.

The sole symptom is severe, more or less continuous pain in the affected portion of the extremity. This pain may radiate, as from the arm into the forearm or from the thigh into the leg. It may thus be mistaken for a neuritis; and for " neuritis " or " rheumatism " these patients may be treated for a long time before their condition is recognized.

The sole constant objective finding is localized bone tenderness. There may be palpable bone thickening.

The röntgenographic appearance is, as mentioned, that of an osteoperiostitis or that of a former osteomyelitis.

This triad—severe pain, localized bone tenderness, and the röntgen picture—make the diagnosis of chronic medullary bone abscess, if the patient is afebrile. The same pain and tenderness are produced by a

chronic abscess of the bone substance (Brodie), but, to repeat, the röntgenographic appearance will distinguish it.

The clinical course of such a medullary accumulation of pus is essentially chronic. It would seem that it causes neither fever nor prostration. It does cause, or, at any rate, has associated with it, a productive ostitis or osteoperiostitis, which is, perhaps, a reactive rather than a bacterial inflammation. Prompt cessation of pain and tenderness follows the simple evacuation of the pus. There appears to be little or no tendency to bone necrosis; and chronic medullary abscess must not be confused with " ostitis interna " as described by Billroth or the " central necrosis " of Keen, although it may have the same origin. Nor, it seems, is there a tendency to perforation. Of the characteristic typhoid " shirt-stud abscess," a cortical process which, perforating, spreads under the periosteum, Keen [4] says, however, " In this form there is a localized abscess outside the tibia . . . and another similar one under the outer layer of the bone or even in the medullary cavity, the two abscesses being connected by a cloaca or sinus through the wall of the bone . . ." Whether the medullary suppuration in such a case is primary or an extension from the more common cortical typhoid abscess I would not undertake to say; but I have not found recorded any case of pure medullary abscess of typhoid origin.

CASE I.—J. F., male, Austrian, aged twenty-one, clothing cutter, was under my observation continuously during the summer and fall of 1910, when I was in charge of one of the surgical out-patient departments of Mount Sinai Hospital. Since November, 1909, he had had pain in the middle of his left thigh, at first dull and intermittent, but soon becoming continuous and severe and radiating into the leg. There was no functional disturbance, atrophy, fever, or sensory change. In the mid-thigh anteriorly was a palpable, irregular, slightly tender thickening of the femur. Röntgenograms showed that this was produced by an osteoperiostitis, the bone growth extending not only peripherally but also centrally, at one area almost obliterating the medullary cavity. There was no reddening of. the skin. The integument and muscles could be moved over the thickened bone.

The family and previous history were negative; syphilis was excluded by the Wassermann test and by the failure of persistent specific treatment; and the etiology was not discovered. Large doses of aspirin gave no relief.

On July 23, 1910, I transferred the patient to the " second

surgical division " of the hospital, where he was operated upon July 29, by Dr. Buerger. A four-inch incision was made over the mass anteriorly. The periosteum was found much thickened. The projecting bone mass was removed level with the rest of the shaft. Only dense, dry bone was encountered. The muscles and skin were sutured without drainage. Primary union. There was no relief of pain. On August 6 the patient was discharged: " Chronic osteoperiostitis of femur; unimproved," and referred back to the dispensary. Except for a slight elevation the day after the operation, the temperature had not been above 99° throughout his stay in the hospital.

Persistence of the pain made me feel more sure of what I had thought before, that there must be some pus in the medullary cavity. I had the patient re-admitted to the hospital November 5, 1910, and operated upon him November 9. The periosteum was exposed through the line of the former incision. An osteoperiosteal flap was made and reflected. With the chisel the medullary canal was entered, exposing within it a few drops of thick pus (from which I neglected to make a culture). Some necrotic, but not loosened, bone was removed from the depth. The cavity was swabbed with an iodine solution; the bone flap was replaced; and the fascia and skin were sutured without drainage. Prompt cessation of pain. Primary union. Before operation the blood-count showed 16,000 leucocytes; 67 per cent. polynuclears. November 22: Discharged—" Chronic osteomyelitis of femur, with medullary abscess; cured." There was no recurrence of the pain.

Case II.—S. C., male, Russian, aged twenty-three, furrier, was admitted to the third surgical service of Mount Sinai Hospital on May 16, 1916. In 1909 he had been shot in the right shoulder, the bullet evidently traversing the humerus and lodging under the skin posteriorly. It was removed therefrom at the Lincoln Hospital, New York. Thereafter sinuses formed in the shoulder region, discharging pus and occasionally small sequestra of bone. On account of these he was operated upon at the Massachusetts General Hospital in 1913 and a piece of the bullet was then removed. After that a sinus would occasionally form, discharge a small bone fragment and close. At the time of admission there was a remnant of such a sinus, then only skin deep, which had appeared at the upper angle of the anterior incision of the last operation, had discharged scantily and was closing rapidly. The patient complained of severe, fairly constant pain in the arm, referred especially to the junction of the upper and the middle third, and radiating into the forearm.
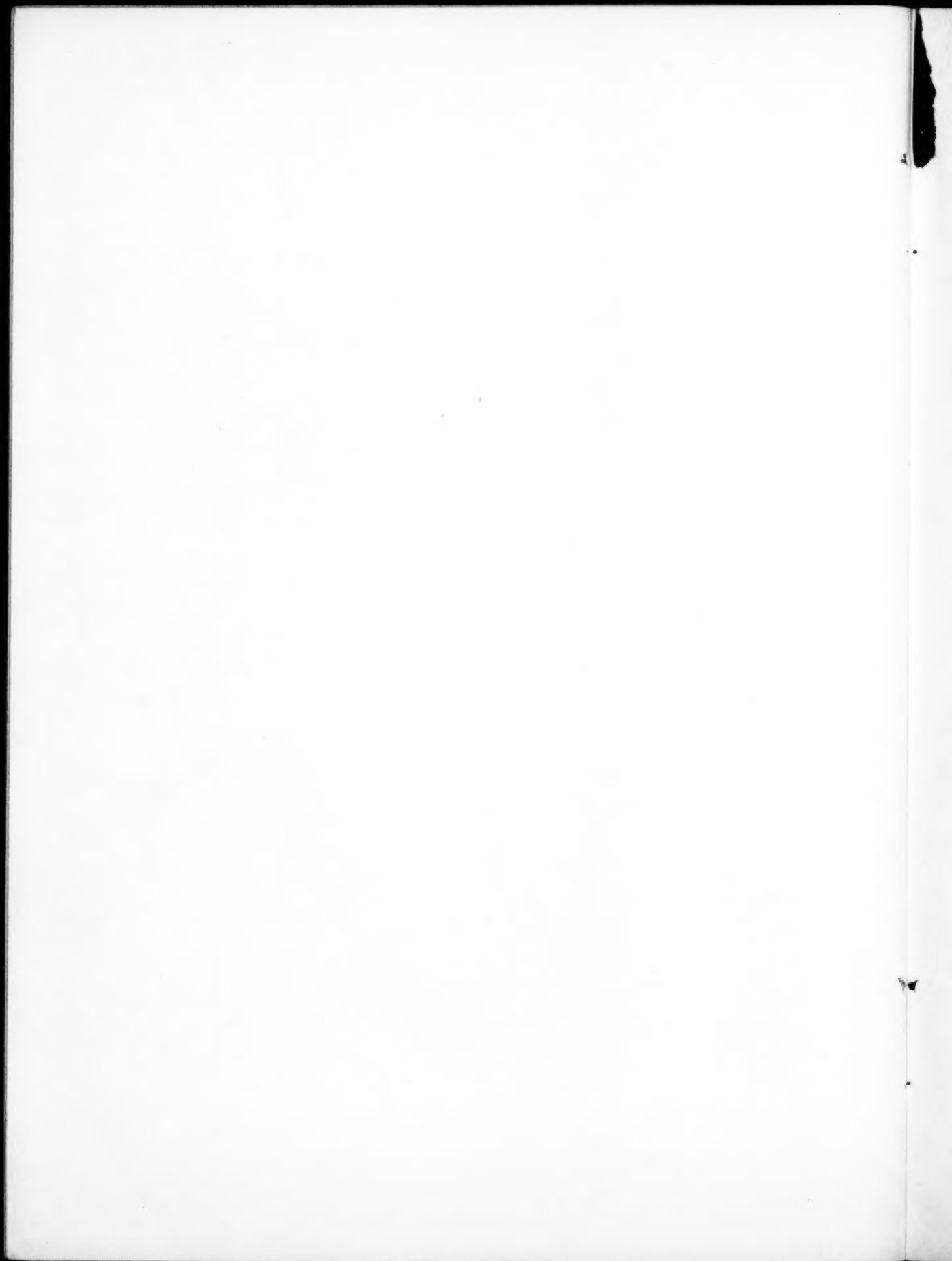
Fig. 1.—Cortical abscess of the shaft of the tibia.

Fig. 2.—Case II. Before operation. Osteo-periostitis with chronic medullary abscess of the humerus. Note the bullet fragments.

Fig. 3.—Case II. Four months after operation. Note that the drill hole has filled with bone and the periostitis has disappeared.

Fig. 4.—Case III. Chronic osteomyelitis of the humerus with medullary abscess.

There was no fever. There was no deformity of the arm, except the scars, and no palpable irregularity or thickening of the humerus. The shoulder and other movements were perfect. There was neither atrophy nor sensory change.

Röntgenograms revealed the presence of minute bullet fragments scattered about the upper portion of the humerus, which showed an osteoperiostitis, with no evidence of necrosis. The periostitis was but slight and chiefly in the deltoid region. The ostitis was in the middle third of the shaft. Here there was slight thickening but the bone growth was chiefly centripetal, in two places obliterating the medullary canal. The head of the humerus appeared quite normal (Fig. 2).

Because of the radiation of the pain, the exquisite tenderness when the brachial nerves were pressed against the humerus, and the röntgenographic finding of the minute bullet fragments, it was thought by some that irritation of the nerves by these fragments was the cause of the man's suffering. I noted, however, that finger pressure against the outer aspect of the bone, just below the deltoid, elicited the same tenderness, and that compression of the nerves between the muscles was not painful. I concluded, therefore, that the lesion was a chronic medullary abscess of the humerus, and in this diagnosis Dr. Moschcowitz concurred.

Operation (Brickner) (May 19).—The humerus was exposed through a 2½ inch incision on the outer aspect of the arm, commencing above over the lowest portion of the deltoid. The periosteum was found thickened. The shaft was entered with a Hudson drill a little below the deltoid apex, but at this point the bone was found solid, the medulla obliterated. A second drill hole was made a little above this (after incising the tendinous deltoid), the marrow cavity was entered, and several drachms of thick, creamy pus welled out. This came down from above, and a large probe passed into the cavity went up into the head of the humerus. At the lower end of the cavity curetting revealed scanty granulations. The canal was wiped out with iodine-wet gauze. (In another such case I shall resist the temptation to investigate the extent and the lining of the cavity.) The two almost contiguous drill holes were made into one measuring about 3 x 1 cm., and just into the mouth of this opening was placed a rubber tube drain (stitched to the muscle). The wound was otherwise closed by sutures. Smears of the fresh pus showed no organisms and cultures no growth.

It was confidently predicted by some of my colleagues that the bone would never heal until the entire pus-containing cavity was laid freely open. Although the wound became infected it

quickly closed, except at the site of the drain. When the patient was discharged from the hospital, two weeks after operation, this opening was but a small granulating wound, discharging a little pus. It soon contracted to a minute sinus, leading to the bone and discharging very little; and by September it was solidly closed and has not since reopened. A röntgenogram on September 25, four months after operation, showed the drill hole filled in with bone, and no evidence of the former periostitis (Fig. 3).

My experience with Case I suggested to Dr. Lilienthal the diagnosis and plan of treatment in the following case, which had been under observation on his service for eight days:

CASE III.—I. B., male, Russian, aged twenty-three, hospital porter, was admitted to the first surgical service of Mount Sinai Hospital, November 15, 1916. In 1906 he had been operated upon for osteomyelitis of the left humerus developing after a fall. The wound continued to discharge and four subsequent operations were performed (1906–1908). Thereafter he was well, had no sinus, and was free from pain until two weeks before admission. For a fortnight he had had much pain in the outer portion of the left arm, radiating to the elbow and to the pectoral region, and worse at night.

There was no fever. Movements of the extremity were unimpaired. The arm was of normal contour but bore five large scars. There was decided bone tenderness below the apex of the deltoid, its maximum at the junction of the middle and the lower third of the humerus. The left epitrochlear and axillary glands were palpable. Röntgenograms showed the familiar picture of a healed osteomyelitis with no evidence of sequestrum or abscess (Fig. 4).

Operation (Lilienthal) (November 27).—Under nitrous oxide narcosis the bone was exposed at the site of maximum tenderness by a 2-inch incision over the outer aspect of the arm. Through the much thickened cortex an opening the size of a dime was made into the marrow cavity with a gouge, and a half ounce or more of thick, buff-colored pus escaped under tension. A piece of gauze was laid between the muscles, but not in the bone, and the wound was otherwise closed with sutures. The pain ceased immediately. The gauze drain was removed on the fifth day, and the wound speedily closed. The patient was discharged December 12 and at once returned to his work, well. Cultures of the pus yielded no growth. The temperature throughout was not above 99°, except the day following operation (100°).

These chronic medullary abscesses are probably most often, perhaps always, residual from an osteomyelitis, as typified by Case III. Perhaps, however, they may develop sometimes from a pure infection of the bone marrow, either hæmatogenous or, as from a bullet or a surgical instrument, direct. This hypothesis is suggested by Case I and Case II, in both of which, however, there had also been some necrosis of the bone. In his explanation of bone abscesses as a development of circumscribed osteomyelitis, Hildebrand [5] says: " If the medulla in the centre of a long bone is affected in a limited area there is no opportunity for sequestrum formation, for there is no bone there; there forms then simply a cavity lined with granulations, with or without pus " (translation). If there is no opportunity for bone necrosis (compare Case I) such a condition cannot be regarded as even a circumscribed osteomyelitis, *as we use the term clinically,* but would be what I have just suggested hypothetically, purely a marrow infection—an osteal myelitis.

Whether these chronic pus accumulations always eventually become sterile, and the condition always afebrile, I do not know. In a recently observed subacute case in which the signs and symptoms suggested a medullary abscess, but in which there was fever, I found not merely a large amount of pus in the marrow cavity, but an active and extensive " osteomyelitis."

If the pus is sterile the pain seems best explainable by the pressure under which the fluid is confined. This, rather than the osteoperiostitis, probably also explains the tenderness which, like the pain, disappears promptly after the escape of the pus.

In spite of preconceived notions, evacuation of the chronic medullary abscess through a drill or trephine hole in the bone seems to me the method of choice, and the excellent results in Cases II and III support this contention. Admittedly such early healing may not always follow. As a result of secondary infection, or perhaps from the awakened activity of dormant organisms, continued suppuration or a localized bone necrosis may develop. But if these do not subside spontaneously they can be dealt with secondarily by an operation probably much less extensive than a primary exposure, by bone removal, of the entire pus cavity. Such a procedure in Case II would have meant chiselling away the bone into the head of the humerus itself—a rather formidable operation that would have entailed prolonged hospital care and loss of employment, and perhaps much permanent disability. By the simple trephine drainage this patient, like

Case III, was immediately relieved and was restored to full activity in two weeks! So, also, was Case I.

Even in acute osteomyelitis it is not always necessary to remove bone over the entire length of the suppurating medulla. If it appears viable and sound, several inches of the shaft may be left undisturbed after evacuating its medullary pus with a spoon.

After trephining a chronic medullary abscess the cavity probably fills with granulation tissue. Such filling is apparently not necessary to the healing over of the soft parts, however, for in Case III the wound was definitely closed in ten days or less.

In selecting the spot for draining the bone the point of maximum tenderness is the best guide. The röntgenogram is helpful in indicating, sometimes, a level where the medullary space would be found obliterated. The technic adopted by Lilienthal appears to me the wisest, viz., to introduce nothing into the cavity except the single instrument by which it is opened; to insert a small gauze, rather than a tube, drain down to but not into the bone, with which to provide for the escape of any remaining pus, of blood and of serum; and to remove this, preferably without replacement, as soon as the discharge has practically ceased.

I wish to thank Dr. L. Jaches, röntgenographer of Mount Sinai Hospital, for these röntgenograms, and Dr. Samuel K. Levy of the house-staff for his assistance in abstracting the case histories.

REFERENCES

[1] Bowlby, Sir Anthony: Surgical Pathology, 5th edition. London, Churchill, 1907, p. 296.

[2] Peters, George A.: Toronto, in Bryant and Buck's American Practice of Surgery. New York, Wm. Wood & Co., 1907, p. 314.

[3] Mumford, J. G.: Practice of Surgery. Philadelphia, W. B. Saunders & Co., 1914, p. 964.

[4] Keen, Wm. W.: The Surgical Complications and Sequels of Typhoid Fever. Philadelphia, W. B. Saunders, 1898, p. 136.

[5] Hildebrand, Otto: Allgemeine Chirurgie. König's Lehrbuch der Chirurgie, 4te Band, 2te Auflage. Berlin, Hirschwald, 1905, s. 758.

THE TREATMENT OF FRACTURES OF THE FEMUR, ESPECIALLY IN THE OLD*

By George Tully Vaughan, M.D.
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Fractures of the femur are, of themselves, always serious injuries, and differ from fractures of the skull, which are serious only in proportion to the damage done the brain or vessels. Of all the bones in the body, this is the one whose fracture, independent of surroundings or adjacent structures, is followed by the most serious results—whether it be neck, shaft, or extremity.

Fractures of the *shaft* are most frequent during the strenuous period of life, say fifteen to forty, while those of the *neck* are much more frequent after the age of forty, and especially in old women. Fractures of the neck occur occasionally in young children. For years the opinion has prevailed that the mortality in the old is very high and that the only possible chance to save the patient's life is to adopt some form of treatment that will not confine the patient to bed.

The mortality is high under any method of treatment, not necessarily because of confinement to bed, but chiefly owing to the fact that the femur is the great marrow bone of the body, containing more fat than any other bone; therefore the patient is more likely to have fat embolism than after fracture of any other bone. I believe the most frequent cause of death is thrombosis with embolism either from fat or blood-clot, and it is liable to occur in any patient whether operated on or not. How much infection has to do with it is not known. In some cases it can be traced to a probable infection, in others there is no such probability. No doubt many of the cases of pneumonia, of arrested renal function and of coma are due to emboli in the lungs, the kidneys, or the brain, as the case may be.

The question of *treatment* is often a difficult one to settle. The surgeon wants to select the method which is least dangerous to life, and at the same time the one which will give the best results in the broken bone, functionally and anatomically. The safest method, so far as life is concerned, is often the one which would inevitably give poor functional and anatomical results. Perhaps the method safest to life

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would be to make the patient comfortable, straighten and fix the limb without attempting to reduce the fragments by much extension, counter-extension, rotation and manipulation.

The result in such cases would be shortening and perhaps a lack of correspondence in planes and axes of the two segments, yet the functional result might be good in spite of the deformity.

On the other hand, under an anæsthetic to push, pull and manipulate or to do an open operation and put in a bone splint, or metal plate, would probably give a perfect functional and anatomical result, but the danger to life would be increased. Yet the patient is usually willing to incur a slight risk to his life for the sake of getting a good and useful member and he is quite justified in taking the risk. So, in every case, to the conscientious man, it is a question of nice surgical judgment, and the surgeon should give the patient the same advice that he would take if he were in the patient's place.

In fractures of the *shaft* good results can sometimes be obtained by means of Buck's extension, Hodgen's and N. R. Smith's methods. Wires, nails and screws alone are not as desirable as plates, bands, bone-splints, or interlocking.

My first choice of means to hold the fragments together was silver wire, which I soon abandoned for iron wire, which I found cheaper and stronger and no more likely to be followed by infection. In an article entitled " The Operative Treatment of Fractures—Especially of the Long Bones," published in the *Trans. Med. Society of Va.*, 1906, and *American Journal of Medical Sciences* for March, 1907, I referred to over one hundred cases I had operated on, in most of which wire was used, and the various methods of using wire were shown by drawings.

Since then, with increased experience and observation, I use less wire and more of other means for maintaining coaptation. For oblique fractures the steel bands of Parham and Martin impress me as being superior to wire. They are very strong and are applied without drilling holes in the bone.

The metallic plates most commonly used are those of Lambotte and of Lane. Good results are reported from the use of both. I have not used Lambotte's plates because their size, covering something like one-third of the circumference of the bone, impressed me as more objectionable than Lane's plates which are attached to a much smaller surface. The Lambotte plate, however, holds the fragments more securely and there is less need of an outside splint when it is used.

The Lane plate gives good results in suitable cases and when properly applied. Like all other new things—new medicines, new instru-

ments, new methods, new fashions—it has been used by men of poor judgment in unsuitable cases and hence has received much adverse criticism—some of it by men who have never used it and are not competent to criticise it. It should not be used by a slovenly surgeon or one who does not practise, or have the facilities for ensuring, the strictest asepsis. I have used the Lane plate in a number of patients with fine results. In some I have had bad results, but it would hardly be fair to lay the blame on the plates. For example, in a compound comminuted fracture of both bones of the forearm sent to hospital for amputation, I decided to try to save the limb and applied plates to the broken bones. The patient did well for two weeks, but left the hospital against advice, had a bad infection and finally suffered amputation of the forearm. However much room there may be for speculation as to what might have been, no fair-minded man would condemn the Lane plate for a failure to cure this case. Patients whom I have plated years ago are going around attending to their business and would not know of the presence of the plates had they not been told.

An instructive case is reported by the Vander Veers of Albany, in the *Transactions of the American Surgical Association* for 1914: A man with both femurs broken practically alike was treated by reduction, a Lane plate on the right femur and plaster of Paris on the left side. The final result showed quicker and better union on the side of the Lane plate. The inevitable conclusion from this one case is that the plate properly applied does *not* cause *delayed* union. Many others could be cited which confirm this opinion. We know that delayed union and ununited fractures were not uncommon in the days before open operation came into use. Warren reported a case of complete absorption of the humerus after a fracture.

I do not perform open operation or put foreign material in the tissues unless I think the indications therefor are clear and convincing.

Frequently after exposing the fragments by open operation they can be adjusted in such a manner as to stay in place without other aid than that of external splints. For some years I have been using two methods to avoid the use of foreign material in the tissues, one of which I have never heard of any one else using, and that is to insert the sharp end of one fragment into the medullary cavity of the other until firm fixation is obtained without shortening of the bone. Sometimes in order to accomplish this, it is necessary to shape the fragments to some extent with cutting forceps. The other method is to use an intramedullary splint of bone, preferably taken from the bone operated on. In case of the femur a fragment an inch or an inch and a half long and

thick enough to fit tightly into the medullary cavity, is removed from the bone a short distance from the site of fracture but through the same wound and then inserted into the medullary cavity of the two fragments. This is suited for transverse fractures and prevents overriding, but not bending, which is prevented by a plaster-of-Paris cast.

The first method is used in oblique fractures.

I have had no experience in the use of the Codivilla-Steinman method of extension by means of nails or skewers driven into or through the bones.

Fractures of *the neck of the femur* if *impacted,* with little or no deformity, should be treated by plaster of Paris from chest to toes on the affected side with the limb in the normal position of extension parallel with its fellow.

Fractures with *separation* of fragments should be treated by the Whitman method of abduction. Then if the Roentgen ray shows the reduction unsatisfactory open operation should be done, unless there are contra-indications, and the fragments fixed in some manner which seems best. I have had the best results with steel screws, 3 to 4 inches in length, passed through the base of the trochanter major and the femoral neck into the head of the bone. I have used nails but think they are inferior to screws.

Ununited fractures of the neck should be treated in the same way. Plaster of Paris should be applied from chest to toes in all cases, and kept on or renewed for a period of about three months, and no weight should be borne on the affected side for at least 4 months. I usually tell my patients with fractures of the *neck* that they may walk again after from 6 to 12 months. No one knows definitely when a broken femur will unite, and it is best to be on the safe side. Patients are quite comfortable in the plaster and should be frequently turned over on either side or on the face to prevent hypostatic congestion, and can be brought up in a slanting position by raising the head of the bed.

FRACTURES THROUGH THE NECK OF THE ASTRAGALUS

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Fractures through the neck of the astragalus were formerly thought to be relatively rare. It is certain, however, that they are more common than the earlier publications dealing with this subject would seem to indicate. Golebriwski has personally observed 77 fractures of the astragalus and Borchardt saw 12 within a few years.

Fractures through the neck of the astragalus are of especial interest, for the fragments may be displaced in a number of different ways, and the functional integrity of the ankle-joint may be seriously interfered with unless proper surgical procedures are instituted early.

Fractures through the neck may occur without any displacement of the fragments. In such instances the ligaments may remain sufficiently intact to hold the fragments in place. Fracture of the neck without displacement is rare. Baudet, in his recent monograph on fractures of the astragalus, found but five of this type, one being reported by Menissez, two by Louis and two by Mauranges.

Displacement of one of the fragments is the rule and usually it is the anterior one. Most commonly this fragment is displaced upward and forward, overriding the posterior fragment, the scaphoid or cuboid. In this form of displacement, the fragment can usually be felt beneath the skin in front of the ankle-joint. In a few cases the displacement has been downward, the anterior fragment then being found beneath the posterior. The prognosis in cases in which the anterior fragment is displaced is usually good. As a rule the functional result is good even when reduction is not possible, and the fragment has to be removed.

In a smaller proportion of fractures through the neck the posterior fragment consisting of the body and possibly a part of the neck is displaced. The prognosis of this type of displacement is doubtful from the functional viewpoint. An open operation is usually required to reduce the dislocated fragment, and the injuries of tendons and nerves may complicate the fracture.

Forward displacement of the posterior fragment is very rare, but two cases having been reported, both verified by operation (Morestin and Couteaud). In this type of displacement the posterior fragment had been forced out of the joint and rested beneath the skin in front of the external malleolus. Direct backward displacement with-

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out rotation of the fragment is equally rare, only two cases having been reported (Rondeau, Ombredanne). In this type of injury the calcaneomalleolar ligaments are ruptured, allowing the foot to be displaced forward, while the astragalomalleolar ligaments remain intact. The posterior fragment when the dislocation is completed rests upon the retroarticular surface of the os calcis. The posterior fragment is, however, not rotated on its axis.

Displacements of the posterior fragment with rotation upon its axis are more frequent. The fragment may be so rotated that the articular surface of the astragalus rests upon the tendo achillis. The fragment may be displaced to the inner or outer side of the tendo achillis and come to rest behind either the internal or external malleolus.

The following history deals with a fracture through the neck with displacement with rotation of the posterior fragment. The line of procedure followed in this case can be used to advantage in all fractures of this type.

G. W. B., twenty years of age, was admitted to the Presbyterian Hospital on the service of Dr. Dean Lewis, May 14, 1916. He stated that ten days before he had sprained his ankle. When the accident occurred he was running down the side of a ditch trying to catch a baseball, and the spike of his shoe caught on a tin can, throwing him forward from the ankle. He was then taken to a local hospital, where the fracture was recognized and an unsuccessful attempt made at reduction. The following morning ether was administered and another attempt was made to reduce the fracture dislocation without success. The foot was then immobilized.

Ten days after the accident he was admitted to the Presbyterian Hospital. An examination made at this time revealed a swollen left ankle which was tender. Attempts at movement of the joint were painful. A hard mass could be felt behind the internal malleolus, between it and the tendo achillis and a little to the front of the median side of the latter. This was evidently a displaced fragment of bone. The toes were strongly flexed and the patient complained bitterly of the marked flexion of the toes, which he said caused him much pain. Evidently both the flexor longus digitorum and flexor longus pollicis were stretched over the displaced fragment.

An X-ray picture of the ankle (Fig. 1) revealed a fracture through the neck of the astragalus. The posterior fragment composed mostly of the body of the bone had been forced out of the joint and rotated on its transverse axis so that the articular surface rested upon the tendo achillis. The lower end of the tibia

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FIG. 1.—Showing position of the fragments before operation.

FIG. 2.—Plate showing astragalus five months after operation.

FIG. 3.—Lateral views of feet, showing absence of deformity and line of incision. Taken eight months after operation.

projected into the defect resulting from the separation of these two fragments.

Operation (May 1, 1916).—Under ether anæsthesia; to replace this dislocated fragment. An incision measuring about four inches in length was made behind the internal malleolus over the displaced fragment. The posterior tibial nerve was torn and the ends were found separated a short distance. The tendon of the flexor longus hallucis was crowded outward and backward by the fragment and was divided in order to render reduction of the fragment more simple. Attempts at reduction were unsuccessful until the tendo achillis was divided. The foot could then be brought into extreme dorsal flexion, and when the foot was in this position the dislocated fragment could easily be replaced. There was no tendency for the fragment to become dislocated, and consequently no attempt was made to fix by any mechanical means the two fragments of the astragalus. An end-to-end suture of the posterior tibial nerve was performed, and the ends of the flexor longus hallucis sutured. No attempt was made to suture the ends of the tendo achillis. A cast was applied and the ankle was immobilized for eight weeks. After eight weeks the cast was removed and the patient was encouraged to use the ankle.

Eight months after operation the patient has practically complete function of the ankle-joint; all motions being practically of normal extent. The toes have never completely recovered, and in Fig. 3, a lateral view of both ankles, some deformity of the toes can be seen. An X-ray picture taken five months after reposition of the fragment would indicate a union of the lower half of the line of fracture. There is a defect in the upper half of the line of fracture, but union has apparently occurred. This statement is based upon findings revealed by manipulation of the ankle-joint.

As far as can be determined by looking over the literature, 18 cases of backward dislocation of the posterior fragment associated with rotation have been observed. Baudet collected 12, Rixford reported 2, Robinson 3, and Borchardt reproduces an X-ray picture of Kohlhardt's case in the *Handbuch der Praktischen Chirurgie*. The one just reported above makes a total of 19 cases.

Partial astragalectomy has apparently been the operation of choice in most of these cases. This operation was performed in 10 cases, with 5 good and 4 unsatisfactory results. In one case the result was unknown. Total astragalectomy was performed five times. Apparently the results following total astragalectomy were satisfactory, but it is difficult to see why this operation should be resorted to when reposition of the fragment is so easy if the patient is seen within a relatively short time after

the injury. In 3 cases the posterior fragment has been replaced with good results. In 1 case total astragalectomy was resorted to after reposition of the fragment had proved unsuccessful because of infection. In one case the line of treatment pursued is unknown.

None of the arguments which have been made against the reposition of the fragment are valid. Some have thought that callus formation might interfere with the motions of the ankle-joint. In the cases in which reduction has been attempted no such result has followed. Necrosis of the fragment has also been feared, but even when this fragment is completely separated it can be replaced without fear of necrosis, for it has as many if not more chances for survival than a free bone transplant. Rixford replaced the dislocated fragment in one of his cases and united the two fragments with a silver wire. The result was good and the ankle-joint approached more nearly in appearance the normal one than in the case in which he resorted to partial astragalectomy. Urban secured a splendid result after open reposition of the posterior fragment. Robinson, dissatisfied with the deformity and poor function which followed astragalectomy in his first two cases, replaced the fragment in his third case and secured a much better result.

If the nature of the injury is recognized the fragment can be easily reduced by an open operation. When once in place the dislocated fragment tends to remain in place if the foot is held at right angles. No mechanical means of fixing the fragments are required, for alignment is almost perfect when the fragment is placed back in the joint cavity.

Rixford classifies this as a cleavage fracture. The mechanism is as follows: The foot is held in extreme dorsal flexion as in running down an incline. With the foot in this position, it is caught upon some object and the neck of the astragalus is divided by the anterior edge of the lower articular surface of the tibia. The force continuing exaggerates the dorsal flexion of the foot and the posterior fragment is forced out of the joint.

REFERENCES

Baudet, R.: Rev. de Chir., 1914-1915, pp. 305-376.
Mauclaire et Petiteau: Arch. Gén. de Chir., 1909, pp. 575-594.
Mauranges: Thèse de Paris, 1913.
Rixford, Emmet: Bryant and Buck Surgery, vol. iv.
Robinson, E. F.: ANNALS OF SURGERY, Philadelphia, 1916, lxiii, 606.
Goldammer: Beitrage klin. Chir., 1914, vol. xcii.

SUPERNUMERARY BONES OF THE FOOT

AN X-RAY STUDY

By Samuel Kleinberg, M.D.

of New York City

(From the Radiographic Department of the New York Hospital for
Ruptured and Crippled)

This communication is prompted by the comparative frequency with which the writer has observed, in the routine X-ray examination of feet, supernumerary bones as well as marked variations in the outlines of the astragalus and os calcis. The recognition of these conditions is especially important when examining a foot that is the seat of inflammation or that has undergone an injury. Supernumerary bones have been erroneously diagnosed as fractures; and irregularities in outline interpreted as evidence of inflammation.

Some years ago Dwight, in an extensive anatomical study, called attention to the existence of definite accessory bones in the feet and hands, described in detail their usual shape and position, and mentioned that many of these, particularly in the foot, may be readily recognized in radiograms.

In many branches of medicine a physician rarely sees the picture, when sending a patient for an X-ray. He usually accepts the radiographer's opinion and abides strictly by his interpretation. For the orthopædist, however, it is essential to have an accurate knowledge of the radiographic appearance of the foot in order that he may be able to correlate the subjective symptoms with the objective findings.

A brief review of several cases will serve to indicate the practical application of this study.

CASE I.—J. A., male, forty-five years old, was sent to me by his physician for spurs of his heels. The man had for several months been complaining of sensitiveness of his heels, pain in his feet and undue tiredness after moderate exertion. There was no history of any injury, associated illness as arthritis, or venereal disease. Having been treated for rheumatism without relief, an X-ray of his feet was suggested and taken. This showed a sharp spur (see Fig. 16) on the posterior surface of each os calcis at the attachment of the tendo achillis. Though the patient's sensitiveness was on the under surface of the heels, this fact was lost sight of and the presence of the spur influenced the physician to attribute

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the patient's distress to this spur. He was then referred to me. I found that the man had a marked condition of weak foot; there was no tenderness or swelling about the heel cords. The spur was evidently an accidental irregularity in the outline of the posterior surface of the os calcis, a condition not infrequently met with. A pair of Whitman flat-foot braces was applied, the
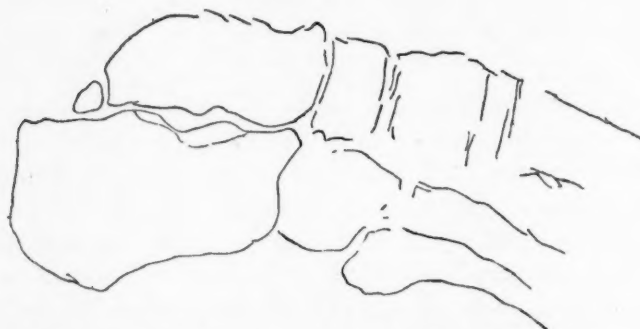

FIG. 1.—L195. Trigonum—separate from the body of the astragalus.

proper shoes and exercises advised, and the man made a rapid recovery.

CASE II.—(Case L340, X-ray series at the New York Hospital for Ruptured and Crippled). Fig. 3 was very interesting. This patient had a fall in which his right foot was injured. The X-ray
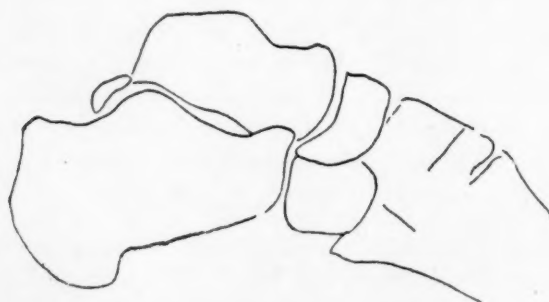
FIG. 2.—L35. Elongated trigonum.

showed a dislocation of the right scaphoid bone; also a mass of bone behind and distinct from the astragalus, which was diagnosed as a fracture of the astragalus. An X-ray of the uninjured foot, however, showed an exactly similar bone in back of the astragalus, the so-called os trigonum, and therefore made it extremely probable that the area of bone, regular in outline, behind the right

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astragalus was also an accessory bone, the os trigonum, not in any way dependent upon the sustained trauma.

Recently I was consulted about an X-ray of a slightly injured foot. The physician thought the case especially interesting because it showed a chipping off of a part of the scaphoid and no other
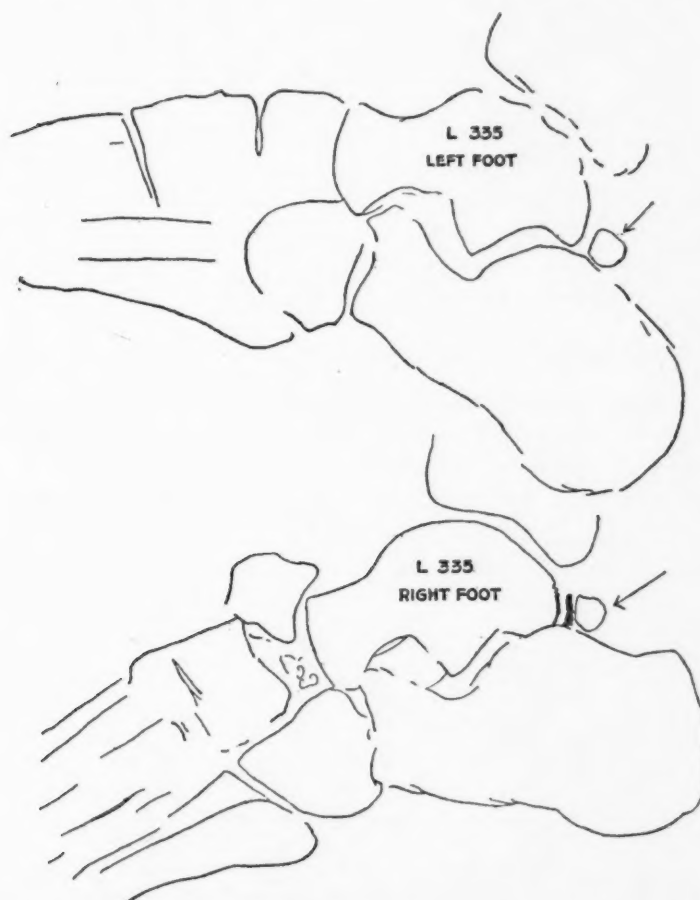
Fig. 3.—L340. Both show trigonum distinct from astragalus. Right foot shows displacement of the navicular, due to injury.

injury. The shadow was perfectly regular in outline and represented the sesamoid in the tendon of the tibialis posticus muscle, called the os tibiale externum.

The irregularities of the dorsal surfaces of the astragalus and scaphoid are interesting because they are sometimes erroneously interpreted as osteo-arthritis.

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From these citations it must be apparent that in the reading of X-rays of feet it is necessary to know the variations in shape of the individual bones, as well as the location and shape of the different supernumerary bones.
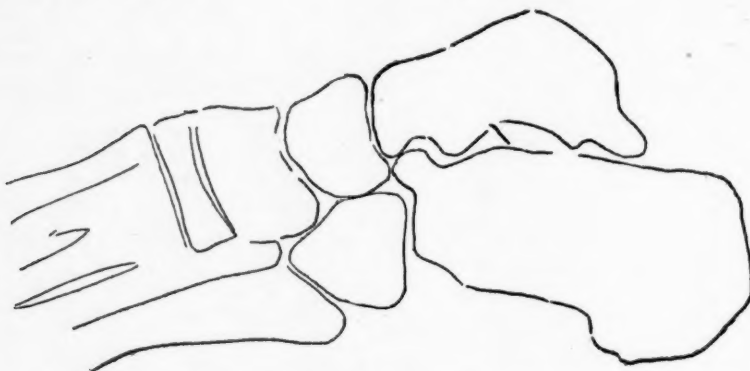
FIG. 4.—L343. Marked projection of posterior tubercle of astragalus. Probably a fused os trigonum.

I am deeply indebted to Dr. Byron C. Darling, radiographer to the New York Hospital for Ruptured and Crippled, for the opportunity to make the study, the results of which are embodied in this article.

Three hundred and fifty X-ray plates of one or both feet were
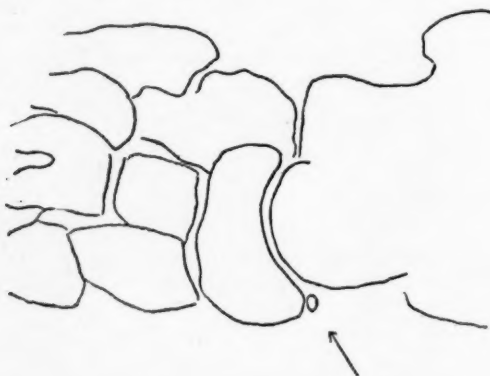
FIG. 5.—L247. Tibiale externum; present only on one side.

examined and of this number 62 showed supernumerary bones. The following table shows their relative frequency:

	Cases	Bilateral	Per cent.
Os trigonum	19	6	5+
Os tibiale externum	12	4	3½
Os peroneale	20	8	5+
Os vesalii	4	2	1+
Secondary os calcis	7		2

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FIG. 6.—Os tibiale externum bilateral. Exceptionally large, overlapping scaphoid.
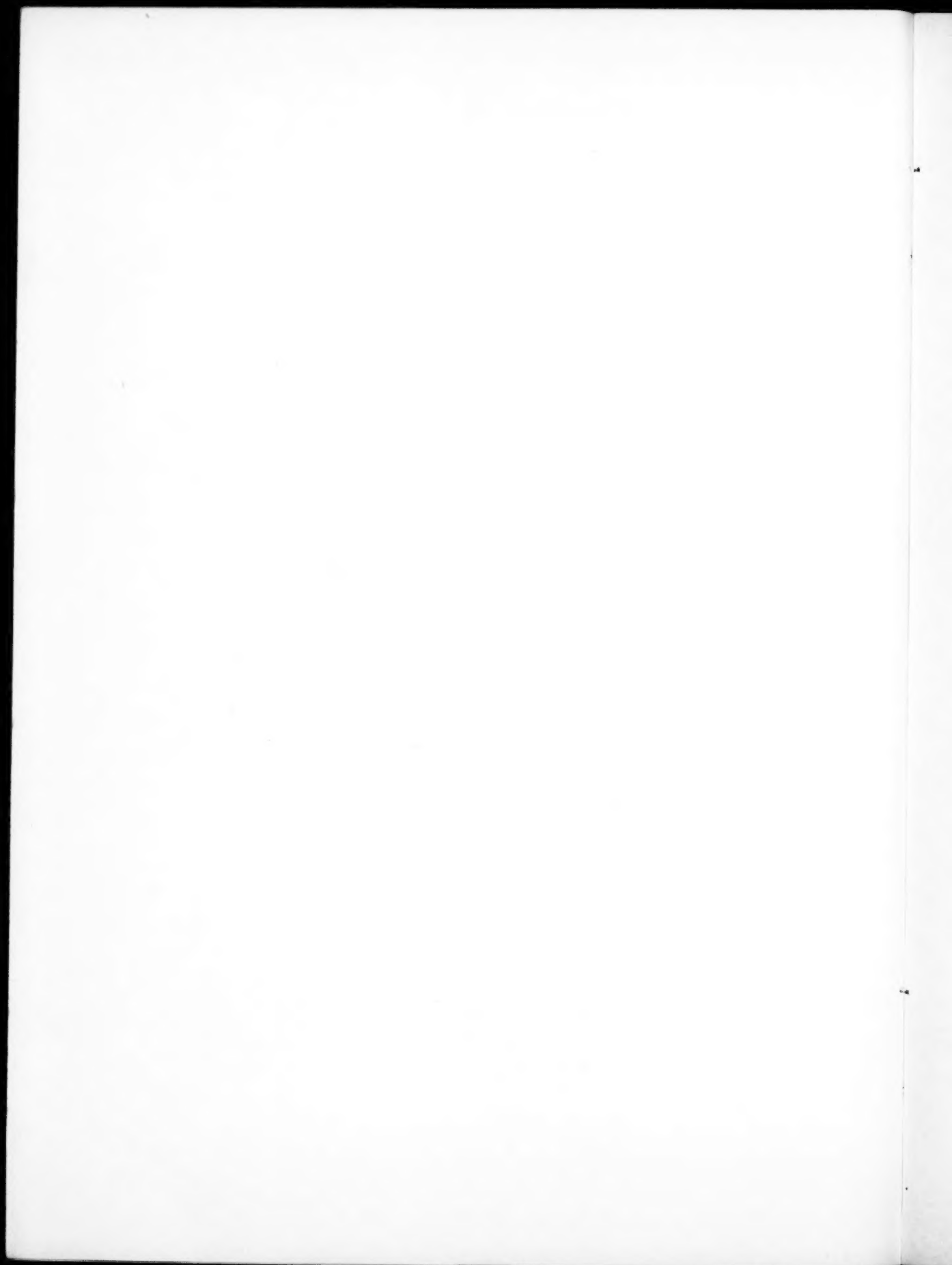
There were in addition 4 instances of divided sesamoids of the big toe tendon. This does not represent an accurate proportion, because many of the plates did not include the front of the foot. There were several instances of spurs on the posterior and inferior surfaces of the os calcis unassociated with any history of rheumatism, trauma or
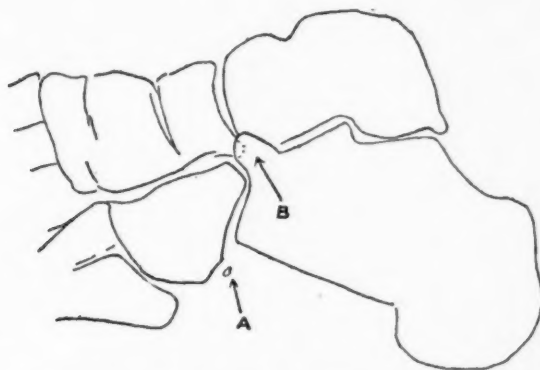

FIG. 7.—L415. Same on both sides. A, peroneum; B, secondary os calcis.

FIG. 8.—L309. Right foot. Very large peroneum.

gonorrhœa, and hence were simply accidental anatomic variations. There were many variations in the outline of the superior border of the astragalus and the posterior and inferior borders of the os calcis. *Variations in the outline of the tarsal bones may be disregarded unless*

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there is clinical evidence attaching importance to them or there are lesions elsewhere in the foot of which these irregularities may be a part.
        Os Trigonum (Figs. 1, 2, 3, and 4).—This bone, like all other super-
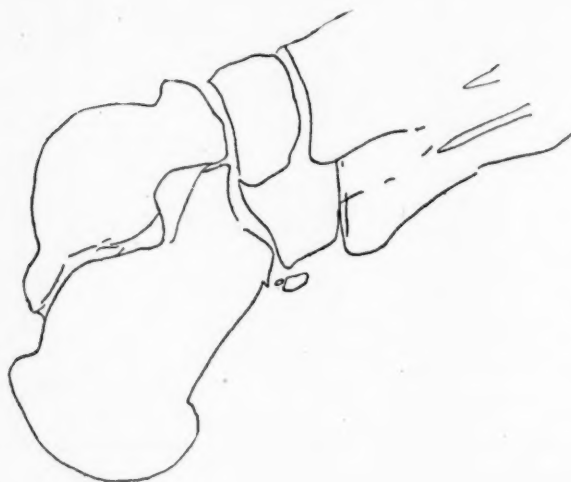

FIG. 9.—K80. Left foot, two "peroneum" bones. Right foot shows only one peroneum.

numerary bones, is characterized by regularity in outline. It may be small or large, may vary in shape from oval to circular or triangular, and may be fused with the astragalus or distinct from it. Of 19 cases,
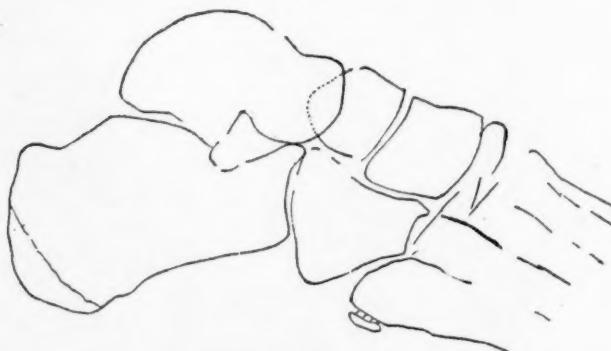
FIG. 10.—L208. Vesalianum.

in 6 it was found in both feet. It may be fused on one side and separated on the other. Its position is constant, being directly behind the astragalus.

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Os Tibiale Externum (Figs. 5 and 6).—This bone is usually circular or oval in outline and situated on the inner side of and slightly behind the scaphoid. It is important to remember that when this bone is distinct from the scaphoid, its shadow sometimes overlaps that of
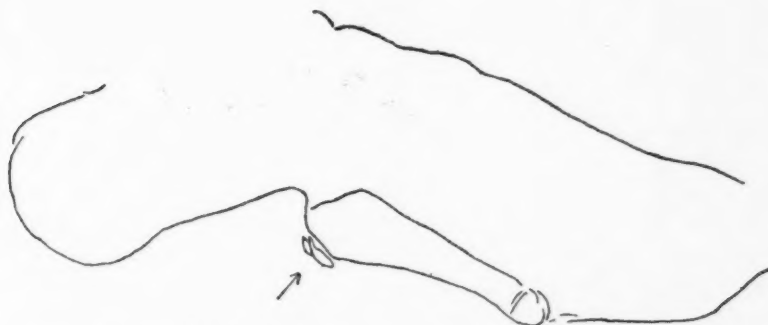

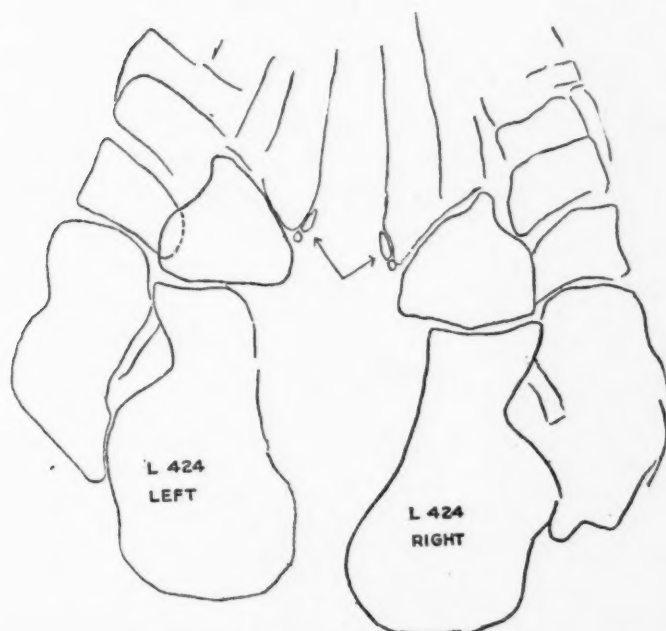FIG. 11.—K175. Both feet show same finding; bipartite vesalianum.

FIG. 12.—L424. Bipartite vesalianum.

the scaphoid. It was found in both feet in 4 of 12 cases. Though it is usually considered as a sesamoid in the tibialis posticus tendon, Dwight believes it to be a true part of the skeleton, since he has found it carti-

laginous in the second month of the embryo. When this bone is fused with the scaphoid one may infer its presence by the size of the prominence.

Os Peroneale or Peroneum (Figs. 7, 8, and 9).—This bone is placed

FIG. 13.—K84. Shows process at anterior superior extremity of os calcis very distinctly, representing probably a fused secondary os calcis.

on the outer side of the cuboid. It is a sesamoid in the tendon of the peroneus longus muscle. In the 20 cases in which it was seen it was always very distinct from the cuboid. It appears to vary in size more
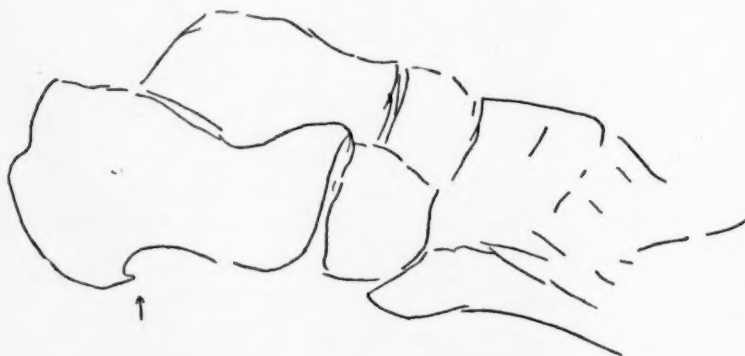

FIG. 14.—L216. Sharp projection of tubercle of os calcis.

than any of the other bones, as is shown in the accompanying illustrations. In 2 instances it was found to be subdivided. It was seen in both feet in 8 of the 20 cases.

Os Vesalii or Vesalianum (Figs. 10, 11, and 12).—This bone is

placed at the proximal extremity of the fifth metatarsal. It was found in 4 cases. In each instance it was distinct and the patient's history excluded the possibility of a fracture. In 2 cases it occurred in both feet and in both instances the bone was subdivided. In one case it was con-
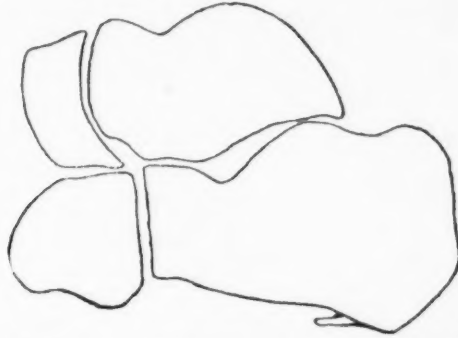

Fig. 15.—L269. Sharp projection of tubercle of os calcis.

Fig. 16.—Spur on posterior surface of os calcis. Same condition on other foot.

nected with the metatarsal by strands of osseous tissue; in the other cases there was a depression in the metatarsal bone corresponding in size and shape to that of the os vesalii.

Secondary Os Calcis (Fig. 13).—This was never seen as a distinct

bone, but in 7 cases there was an unusually long projection of bone in the interval between the astragalus, scaphoid and cuboid that corresponded with what is described as a secondary os calcis.

Spurs of the Os Calcis (Figs. 14, 15 and 16).—Reference to the drawings will show the outline of this bone to be very variable. The

FIG. 17.—L384. Prominence of superior surface of head of astragalus.

inferior surface frequently presents definite spur formation. This also occasionally occurs on the posterior surface. In one case there were two bony spurs on the inferior surface. These must be considered simply as accidental bony projections into the muscle attachments.

Astragalus (Figs. 17 and 18).—The upper surface of the astragalus
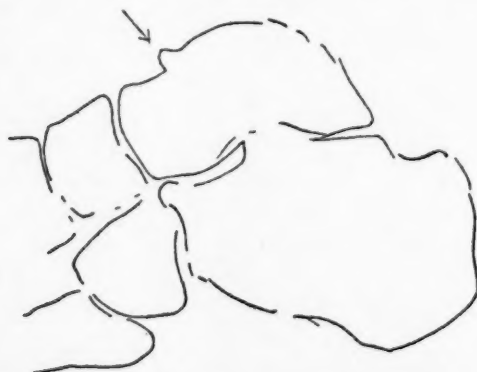

FIG. 18.—L209. Same on both sides—irregularity in outline of superior surface of astragalus.

often presents sharp projections which may also be present on the scaphoid. Such projections occurring in a plate that is somewhat indistinct may simulate osseous hypertrophies suggesting osteo-arthritis.

Sesamoids in the Big Toe Tendon (Fig. 19).—There are usually two sesamoids near the distal extremity of the first metatarsal bones.

Occasionally one of these is subdivided. The writer has seen only split inner sesamoids. The division is made by a transverse line into anterior and posterior parts. Subdivision of the sesamoids has been seen in both feet in some cases and only on one side in others.

Though I have tabulated the number of times I have actually observed each bone, the frequency of their occurrence is not so essential as the knowledge of their existence.
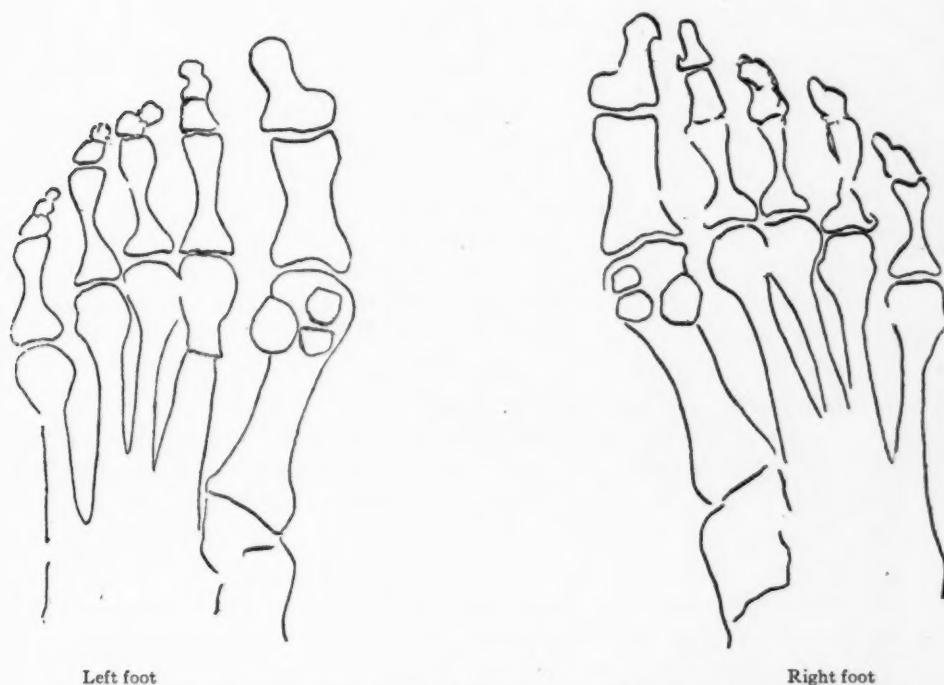

Left foot   Right foot

FIG. 19.—Bilateral split sesamoid. Note fracture of left second metatarsal. Split sesamoid might be mistaken for a fracture. (Ingaborg Anderson.)

CONCLUSIONS

1. Supernumerary bones are frequently found in the foot. Though they vary considerably in size and shape, they are constant in position and regular in outline.

2. Irregularities in the outlines of the tarsal bones often occur as variations in anatomical conformation.

3. It is especially important to recognize the presence of accessory bones and variations in outline in a foot that is diseased or has been injured.

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TRANSACTIONS
OF THE
PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting, Held January 8, 1917

The President, DR. CHARLES H. FRAZIER, in the Chair

MULTIPLE MOVABLE BODIES IN KNEE-JOINT

DR. T. TURNER THOMAS reported the following case: Man, fifty-one years old. Health has always been good except for trouble in right knee of about thirty years' duration. At twenty-one years of age had scarlet fever which left him with a severe inflammation of the right knee. This kept him in bed or on crutches for about eighteen months or two years. At twelve years of age had a severe injury of the soft tissues about the left knee, but he has never had any trouble with this knee since then. The right knee was very stiff after the crutches were given up, but normal motion gradually returned and for many years he experienced no trouble in the use of the limb. About four years ago, this knee suddenly became fixed in flexion, with severe pain and a sense of a giving way of the limb under him. This kind of attack has recurred many times since, sometimes as often as once in every block walked, sometimes not for several days. Frequently, following an attack, the knee swells and then cannot be fully extended. On palpation numerous bodies can be felt moving about in the joint and the femur, tibia and patella are considerably deformed (Fig. 1).

Operation (December 15, 1916).—At the Stetson Hospital. An incision was made on each side of the joint, running vertically alongside of the patella and turning backward along the joint line to its posterior limit. It extended through all layers into the joint. This was essentially the Jones incision for the removal of the semilunar cartilages. Twenty foreign bodies were removed. Most of them were completely detached. Two large, irregular ones were attached. Just below the patella, under the synovial membrane, were two small bodies which were cut away. Above the patella, under the synovial membrane, in the roof of the suprapatellar bursa, were two other small bodies, which were seized with forceps and pulled away. Another was attached back of the external condyle and was pulled away with some difficulty. The wound was closed in layers by catgut, a dress-
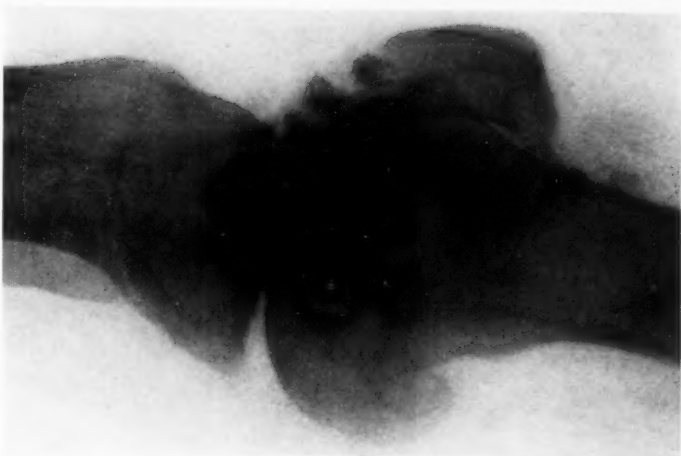
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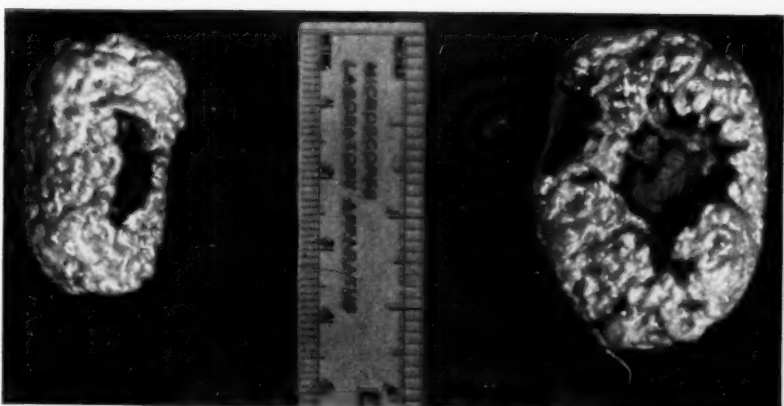FIG. 1.—Movable bodies in knee. Lateral view.

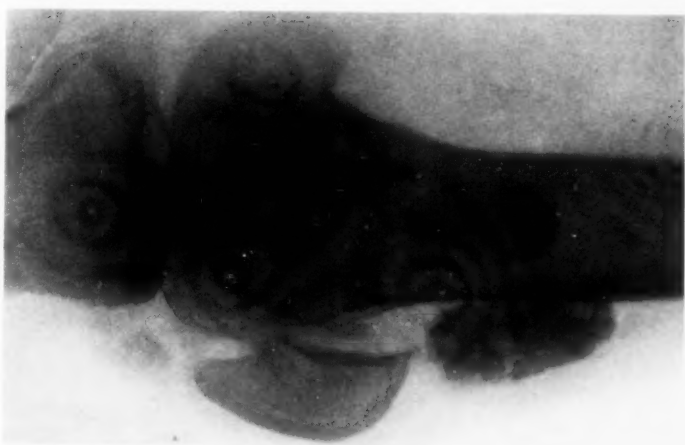FIG. 2.—Photograph of specimen removed from knee-joint.

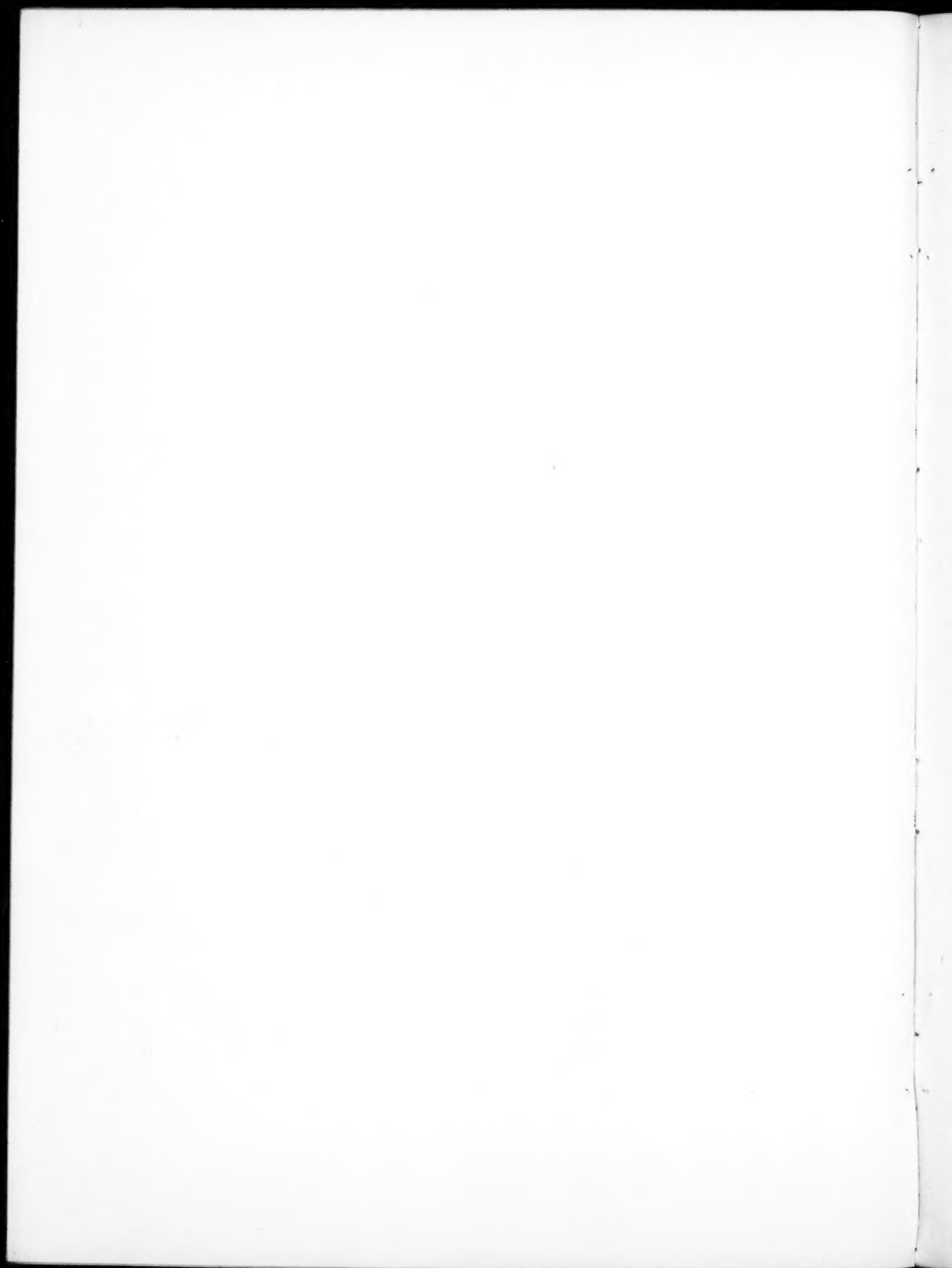FIG. 3.—Röntgenogram of same specimen as Fig. 2.

ing and plaster case applied. Primary healing. Was out of bed in ten days and left the hospital in three weeks, wearing a split case for support and using crutches. As the lateral ligaments of the knee on both sides were completely divided, it is intended to allow them to unite strongly before the case is put aside entirely, which will be done about six weeks after operation.

Dr. CHARLES H. FRAZIER reports also a case in which he removed from the knee two unusually large foreign bodies (Fig. 2). The patient was admitted to the University Hospital September 21, 1916, with the following history: That he had sustained an injury to the knee cap thirty years ago, which gave him, however, very little trouble. Last winter he noticed some pain and swelling in the joint, which has continued to the present time, and he was treated for rheumatism. He also had had pain in both elbow- and both wrist-joints. In other respects the history is practically negative. An examination reveals apparent enlargement of the bones entering into the formation of the knee-joint and two movable masses can be detected in the joint on either side of the patella. The presence of these foreign bodies was confirmed by the X-ray plates (Fig. 3). At the operation an incision was made above the patella through the middle of the quadriceps extensor tendon. The joint cavity was opened and the loose foreign bodies found and removed. No others could be felt. The capsule of the joint appeared to be thick and rather œdematous. The margins of the patella presented the appearance rather characteristic of hypertrophied arthritis. The wound was closed with tier sutures and convalescence was uneventful. The diagnosis returned from the Pathological Laboratory was chondroma.

STRICTURE OF THE ŒSOPHAGUS

Dr. HENRY R. WHARTON reported the following case: Robert T., two years of age, was admitted to the Presbyterian Hospital, November 21, 1915, having a few hours before swallowed a solution of concentrated lye. At this time his condition was urgent, temperature 104.2, pulse 150, respiration very rapid. His condition improved in a few days, but he was unable to swallow semisolids, although he could swallow liquids. Numerous attempts were made to pass œsophageal bougies without success. He took food readily, but it accumulated in the œsophagus and was regurgitated. Under ether anæsthesia attempts were made to pass bougies without success. A bismuth X-ray showed that the stricture was located at the gastric end of the œsophagus. As the patient was rapidly becoming emaciated, in spite of rectal feeding, his weight at this time being twenty-three pounds, on August 19 a gas-

trostomy was done and a No. 16 Fr. flexible bougie was passed,[1] from the stomach through the stricture and brought out through the anterior nares, and allowed to remain in position twenty-four hours. This was replaced by a soft rubber catheter which had a fenestrum a few inches inside the stomach wall, through this liquid nourishment was administered every three or four hours. A shot clamped upon a silk ligature was swallowed and brought out of the gastrostomy wound. By means of this ligature bougies were passed at intervals through the stricture and also a strong silk ligature was passed with which Abbe's operation was done on two occasions. Gradual dilatation was practised with bougies until a No. 30 could be passed. The gastrostomy wound healed promptly and the patient can now swallow solid food. He is now in good condition, weighing thirty-three pounds. On account of the tendency to recontraction of the stricture, bougies should be passed for some time.

CYST OF THE TIBIA

DR. JAMES K. YOUNG reported the case of a white girl, of Russian birth, thirteen years old, who came under observation at the Polyclinic Hospital in May 22, 1916, suffering from osteitis fibrosa cysticus, of three years' duration, of the lower end of the tibia (Fig. 4). There was a large mass, 5 cm. in each diameter, occupying the outer malleolus and including the entire lower portion of the tibia, there was also a longitudinal scar over this region from a previous operation performed two years ago by Dr. D. L. Despard, who incised the cyst which was found to contain a soft sanguineous mass which was thoroughly cauterized with carbolic acid and treated with alcohol, and the wound closed. After this some improvement was noticed. The examination had shown that the walls of the cyst were thin; it was sensitive to pressure and had been increasing in size. The condition was differentiated from giant-celled sarcoma, which was the condition it most resembled, by the length of time it had existed, the slow growth, and the X-ray appearance. Three methods of treatment were presented. First, a conservative treatment; second, excision and bone transplantation; third, curettement and bone transplantation.

1. Under the use of a weight sustaining apparatus and alterative treatment with local and X-ray treatments, the X-ray pictures showed a distinct change in character, becoming more dense, the cyst diminished in size and lost its sensitiveness. 2. The second method is not to be recommended, as better results are obtained by curettement. 3.

[1] Retrograde catheterization easier and more successful than catheterization from above.

FIG. 4.—Cyst of the lower end of the tibia.
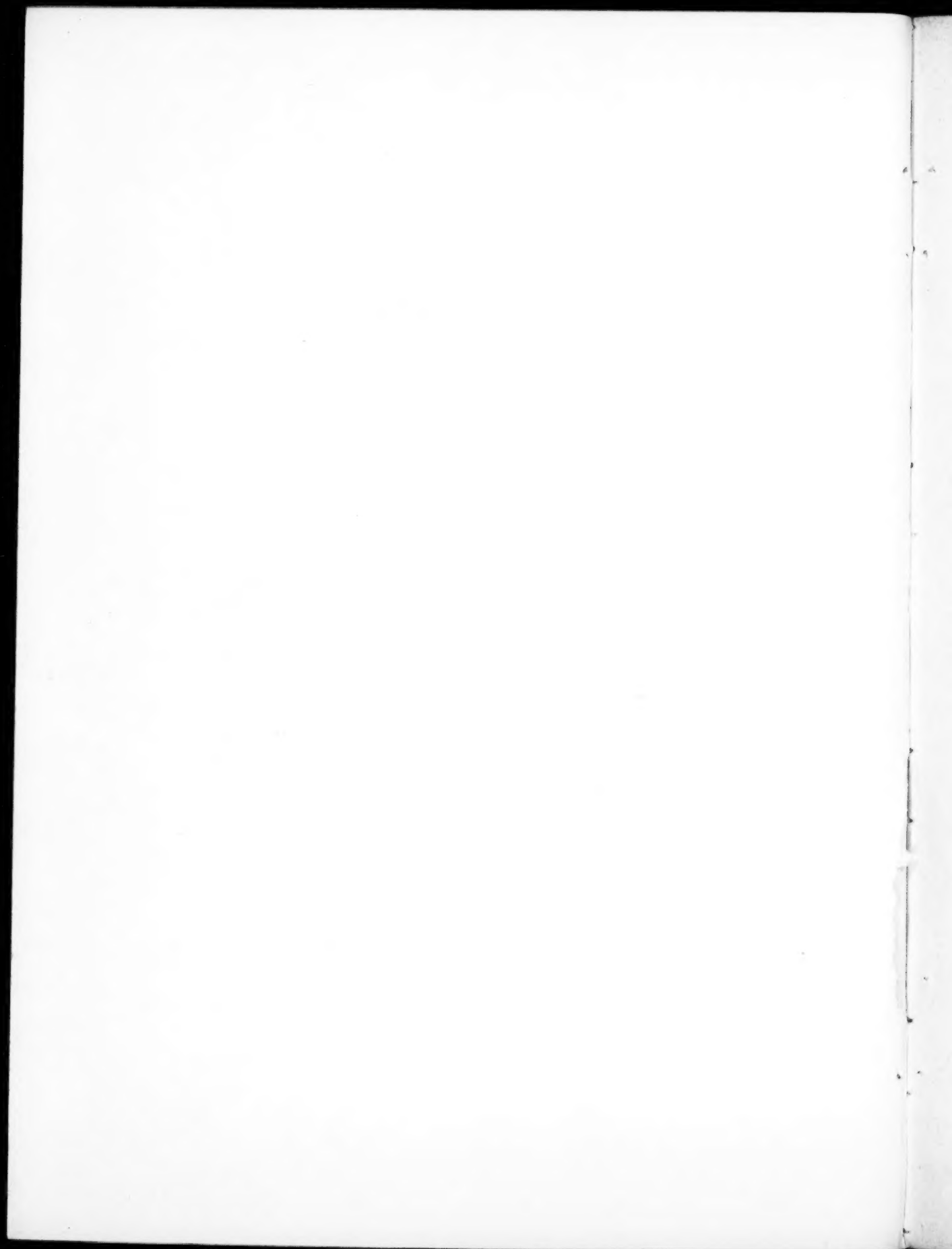
The third method of treatment consists of curettement and bone transplantation. If the bone cyst increases in size and becomes more sensitive, it is proposed to curette the cavity, crush the walls and transplant the fragment of bone in order to retain the shape of the cavity and prevent deformity.

DR. GINSBURG said that two bone cyst cases have been encountered during the past three years in the Fracture Clinic at the Mt. Sinai Hospital. One occurred in the lower extremity of the radius, and the other in the upper extremity of the humerus. Spontaneous fracture occurred in both cases, and during the process of bone repair both cavities were largely obliterated. The bone cyst in the radius appeared to be multilocular, and before union was complete the entire cavity was still not completely obliterated. Pathological fracture appears to be a certain means of obliterating a bone cyst, and is far superior to any surgical method employed.

We know little about the real underlying pathology of bone cysts, and in our cases X-ray plates of other long bones in the body fail to show the presence of cystic degeneration.

G. P. MÜLLER said that he, in 1904, reported a case of benign bone cyst, and wrote one of the first papers published in this country upon this disease, although a number of cases had been previously reported. Since then many more cases have been reported and several good papers, notably those of Bloodgood, Silver and Landon, have been written. Some eighty cases in all have been reported. Dr. Young states that it is his intention to remove most of the wall of the cyst and to transplant bone to take the place of the defect. The simple crushing of the wall of the cyst is sufficient, and is followed by prompt bone formation. Bloodgood has shown this in all of his reports and there does not seem to be any necessity for extensive bone transplants in these cases. In one case reported by Dr. Landon and operated on by Dr. Müller, the patient had a large cyst of the femur surrounded by a mere shell of bone. Crushing part of the walls of this cyst sufficed to bring about a cure. There was entire regeneration of the bone some months later. In looking over the records of Dr. Frazier's service in the University Hospital, the following case has been found which has never been reported:

Elizabeth H., aged fifteen. The trouble began one year previously as a swelling in the hand, without pain, and without history of injury, and with no other symptoms. Examination revealed a spindle-shaped swelling on the fourth left metacarpal, firm but not of bony hardness, and capable of indentation. An X-ray plate revealed a bone cyst.

At operation the shell of bone was partly removed, the interior curetted, and the wound closed without drainage. Two years later the patient was perfectly well and he had not been able to trace her at the present time. The tissue removed from the interior of the bone was typical of granulation tissue with a few giant-cells, and at one place the pathologist reports the presence of cartilage, but on looking at the plate now, they are inclined to believe that the cartilage is not present.

DR. A. P. C. ASHHURST said that these bone cysts in children are practically always benign, but in a patient of eighteen to twenty-five years one must be cautious in regarding them as benign. He had operated on four cases of bone cyst—three in children and one in a girl of twenty-one years. In the latter case the tumor recurred after the first operation. When he did an incision of the bone subsequently all the pathologists to whom he submitted specimens reported the tumor to be a much more malignant type than ordinarily seen in these cases; the stroma was sarcomatous, and did not resemble granulation tissue, as is the case in benign growths.

DR. GWILYM G. DAVIS had operated on a case of this character six or eight years ago in a child of four or five years of age with a cyst of the lower end of the ulna. He simply broke away the outer wall and curetted the cavity, in which there was some granulation material, found to be sarcomatous in structure, and depressed the sides. The wound healed nicely and has remained healed ever since.

ILEOCÆCAL INFANTILE STENOSIS

DR. ASTLEY P. C. ASHHURST reported the following case: Thomas B., aged two years, was admitted to the Episcopal Hospital, November 25, 1915, with symptoms of acute intestinal obstruction. The illness began November 22, with recurrent attacks of abdominal pain; during the attacks the baby gripped his belly with both fists. As he had suffered with similar attacks all during his life, no great alarm was felt. Vomiting set in, however, and on the third day of what was now seen to be the severest attack he ever had suffered, he was sent to the hospital.

Examination at 1.30 P.M., soon after admission: The child lies quietly on his back, apparently exhausted. His eyes are hollow, his tongue and skin very dry. He has just vomited some bile. Since admission there have been several attacks of sudden abdominal pain, the child crying out, and clutching at his belly. There is violent peristalsis. There is no rigidity, except during the attacks of pain. Above

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the umbilicus, a transversely placed, sausage shaped tumor is present, which is slightly movable, and not very tender. A diagnosis of intussusception was made, and the child was prepared for operation.

Operation.—Under the anæsthetic 3 P.M. (gas-oxygen, preceded by morphin sulphate grain $\frac{1}{48}$ and atropin sulphate grain $\frac{1}{400}$) no such tumor as above described could be palpated. It was nevertheless determined to proceed with the operation. A right paramedian incision was made downward for three inches from the umbilicus. There was no peritonitis. The lymphatic vessels of the small and large bowels were
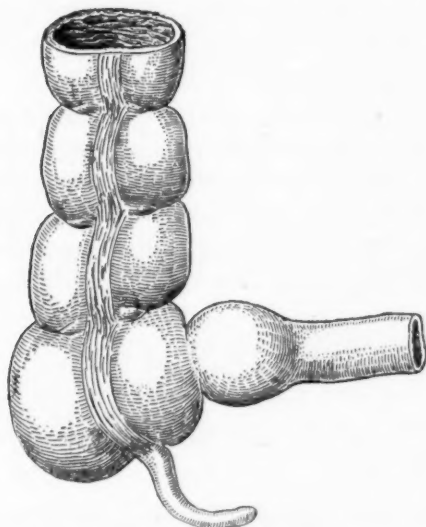

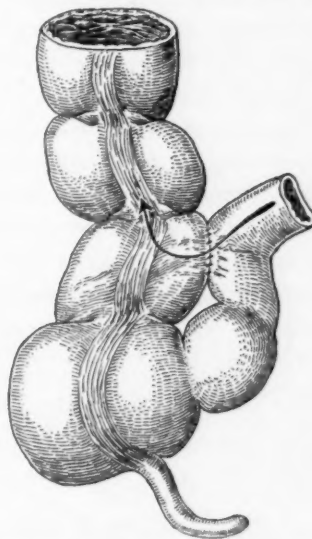FIG. 5.—Tumor of ileum proximal to ileocæcal opening, causing stenosis.

FIG. 6.—Ileocolic anastomosis to short circuit stenosis of ileocæcal opening.

distended. The transverse colon was normal. The small bowel was not distended. A movable mass, the size of a guinea-hen's eggs, was felt in the ileocæcal region. The small intestines were then packed off with pads, and the ileocæcal coil was delivered through the incision. No intussusception was now present, but there was a tumor in the ileum just above the ileocæcal valve, about 4 cm. in length, precisely resembling the tumor seen at the pylorus in cases of infantile stenosis. There were several inflamed epiploic appendages on the cæcum and ascending colon, but no enlarged mesenteric lymph-nodes were detected. The wall of the ileum felt thick, and the lumen appeared to be almost obliterated by the tumor which involved the whole circumference equally (Fig. 5). Apparently there had been an intussusception of this mass into the cæcum and ascending colon. A lateral anastomosis (Fig. 6) was made by suture between the ileum just proximal to the

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mass and the ascending colon (into the anterior longitudinal band, not as shown in the diagram into the median side of the colon). The appendix was not removed, owing to the precarious condition of the patient. The time of the operation was thirty minutes.

Recovery was entirely uneventful. The child was taken home one month later, December 25, 1915; and was seen at first at rather frequent intervals. The child is now in perfect health. No attacks of abdominal pain have occurred since operation.

It was not until after the operation, with its rather disconcerting findings, that it was learned from the parents that the child had been subject since earliest infancy to precisely similar attacks, none of which however had been so severe or had lasted so long as that which finally compelled them to seek hospital treatment.

The question of most interest is whether the tumor caused the intussusception, or whether the intussusception caused the tumor. The former supposition is more reasonable, in view of the fact that repeated but milder attacks had occurred more or less constantly throughout life, and that the tumor had not the least evidence of being due to œdema or swelling. It was as like the tumors seen in infantile pyloric stenosis as one pea is like another.

STAB WOUND OF THE DEEP EPIGASTRIC ARTERY

DR. PENN G. SKILLERN, JR., reported a case of wound of the deep epigastric artery, and supplemented it with a discussion of the surgery of that vessel, for which see page 450.

STAB WOUND OF MESENTERIC VEIN

DR. GEORGE P. MÜLLER reported the case of a butcher, age twenty-five years, who, while at work, slipped and fell against a long, sharp meat knife which he was using at the time. It entered the abdomen. He became faint, and had some abdominal pain, and a few hours later was brought to the University Hospital on the service of Dr. Charles F. Frazier.

The history of the injury, general abdominal rigidity, some dulness in the flanks, and a leucocytosis of 17,000 were suggestive of intra-abdominal hemorrhage, possibly also of peritonitis. Operation was immediately performed (July 14, 1916). On opening the abdomen it was found to contain a considerable amount of fluid blood, and investigation revealed three punctures of the mesentery through which blood was oozing, and a nick in the serous coat only of the intestine, just above the mesenteric wounds. The knife had evidently nicked the bowel, and penetrated the mesentery twice, just as a pin is passed

through a coat lapel. Between the leaves of the mesentery there was considerable bleeding, and this extended for six or eight inches on either side of the wounds. The punctured areas were caught *en masse* and ligatures applied. The blood clots were removed from the abdomen and the abdomen washed out with salt solution. The patient was discharged nine days after the operation and recovery was uneventful.

DR. GWILYM G. DAVIS said that before exploratory operations were as common as they are now he had a case of stab wound of the deep epigastric artery rather high up, just below the lower edge of the ribs. The wound was enlarged slightly but it was so difficult to control the bleeding that he made an incision about an inch below the wound and placed his index finger in underneath and compressed the deep epigastric artery against the abdominal wall. That controlled the hemorrhage and enabled him with the other hand to enlarge the wound sufficiently to control the bleeding vessel without further difficulty. He did not recommend that technic to-day, but it answered well in that case. In that instance there were no such symptoms as mentioned in the paper. In many of these cases of stab wound, although the abdominal wall is perforated, the intestine may not be seriously damaged.

MEDIAN BAR FORMATION IN THE URINARY BLADDER

DR. ALEXANDER RANDALL read a paper with the above title, for which see page 471.

DR. CHARLES H. FRAZIER had under observation a case which might be interpreted as illustrating the type of obstruction which Dr. Randall has referred to in his classification as congenital.

The patient was three years of age. His mother said he was always more or less feverish and urinated frequently. What was thought to be incontinence proved later to be retention with overflow. Owing to an existing cystitis the child complained at times of great pain. The urine contained large quantities of pus and the phthalein test showed but 15 per cent. elimination in two hours on one occasion, 25 per cent. on another. There were occasional rises in temperature, and a provisional diagnosis of pyelitis was made as a complication of the vesical obstruction.

An exploratory suprapubic cystotomy was performed. The bladder was found to be distended, extending up to and above the umbilicus. A careful inspection failed to reveal the cause of obstruction, although in the absence of any form of obstruction in the urethra there must have been some congenital lesion at the urinary meatus which interfered so consistently with the evacuation of the bladder. Although

ample drainage was provided the patient subsequently succumbed to the pyelitis. While the findings were negative, there would seem to be no explanation of the dysuria other than the pressure of some such congenital form of obstruction as Dr. Randall has referred to.

DR. H. L. CECIL, of Baltimore, said that the condition of median bar may be divided into two forms: congenital and acquired. The congenital forms date from birth or early childhood and give symptoms of small stream, weak force, straining on urination, etc., with the symptoms of obstruction as manifested by the patient's general condition. The acquired form usually dates back to middle life or early manhood. The symptoms are essentially the same as in the congenital form, except that the patients are seen earlier in the disease and usually do not show such grave general symptoms. The cause of this form is probably anything that may cause a chronic prostatitis or cystitis; namely, gonorrhœa, sexual excess, sexual excitement without gratification, masturbation, etc. However, many of the patients did not give a history of anything that might have caused the condition, so far as we know.

The symptoms produced by median bar may be divided into (1) urinary, (2) painful, and (3) sexual. Among the cases observed in the clinic of Dr. Hugh Young, at the Johns Hopkins Hospital in Baltimore:

(1) *Urinary Symptoms:* 16 had retention; 11 had incomplete urination; 14 had sudden stoppage; 18 had urgency; 47 had hesitancy; 92 had frequency; 35 had small stream; 28 had weak force; 7 had hæmaturia; 11 had pyuria.

(2) The symptoms of pain may be divided into local and referred: *Local pain:* 12 patients had pain at the end of urination; 24 patients had pain during urination; 6 patients had pain before urination; 5 patients had pain constantly in the region of the bladder; 26 patients had pain at the vesical orifice. *Referred pain:* 18 patients had pain throughout the urethra; 24 patients had pain at the end of the penis; 21 patients had pain in the perineum; 11 patients had pain in the rectum; 7 patients had pain in the back.

(3) *Sexual symptoms: Desire:* Lost, 6 patients; impaired, 19 patients. Erections: Absent, 6 patients; impaired, 11 patients; painful, 1 patient. Ejaculation: Absent, 7 patients; precocious, 5 patients; painful, 4 patients. General symptoms: 4 patients were uræmic; 7 showed definite septic symptoms.

Age: Before 20 years of age, 1 case; 20 to 30, 3 cases; 30 to 40, 8 cases; 40 to 50, 36 cases; 50 to 60, 35 cases; 60 to 70, 30 cases; 70 to 80, 17 cases; 80 to 90, 3 cases.

The cytoscopic findings were as follows: 114 cases had median bar; 36 cases had lateral enlargement; 18 cases had an anterior lobe; 4 cases had polyp at the vesical orifice; 3 cases had hypertrophied trigone; 19 cases had diverticulum; 42 cases had marked trabeculation; 14 cases had vesical calculus.

Residual urine: 3 patients had complete retention; 14 patients had over 200 c.c.; 36 patients had between 50 and 200 c.c.; 74 patients had below 50 c.c.; 6 patients had no residual.

The number of cuts made at the time of operation was judged entirely by cystoscopic findings, three being the usual number and these usually directed posterior, right and left posterior.

Every effort has been made to ascertain the results in these cases by having the patients return for examination and when it was not possible to do this have the patients fill out a circular letter. When patients returned if they had any of the old symptoms, or if on examination residual urine was found, the case was not regarded as cured. Seventy patients were cured; 13 patients were 90 per cent. improved; 16 patients were 75 per cent. improved; 13 patients were 50 per cent. improved; 3 patients were 25 per cent. improved; 13 patients were not improved.

The 13 patients that were not improved were cases in which the principal symptoms were pain, irritation or frequent urination due to contracted or painful bladder, although before operation cystoscopic examination showed a definite median bar. The punch operation was done in these cases in the hope it might relieve the symptoms. These cases may be classified as follows: 3 patients had definite hypertrophy of the prostate; 5 patients had cystitis; 2 patients had pain in posterior urethra; 3 patients had greatly contracted bladder.

A study of these cases shows that the punch operation will do all that it is intended to do, viz.: completely remove obstruction at the vesical neck due to a bar, valve, or circular contraction. It also generally cures the irritation, pain and frequency as well. But in some cases these painful symptoms are due to other lesions in the posterior urethra or bladder, and require appropriate additional measures.

The congenital bars are due, as we have seen them, to hypertrophied muscle of the internal sphincter or a great increase in the connective tissue between these muscle bundles. This type usually shows but little if any inflammatory change. The acquired form may be either inflammatory, which is by far the most frequent, or a definite hypertrophy of the gland tissue.

The inflammatory type shows usually an inflammation, either sub-

mucous, muscular or periacinous or a combination of these. This inflammatory change may be either acute or chronic, though usually chronic and of long-standing. The most frequent location of this chronic change is just beneath the mucous membrane at the vesical orifice. This chronic inflammatory process causes the formation of connective tissue which is piled up at the vesical orifice and subsequently leads to median bar.

The inflammatory change may, however, be deep-seated instead of superficial, in which case microscopic examination shows the muscle bundles widely separated by connective tissue throughout which there is an active chronic process.

Of about equal frequency as the submucous type is the periacinous. Here the most marked inflammatory process is just beneath the mucous membrane of the glands. Further from the glands there is a great increase in connective tissue. In this way there is a great increase in the tissue of the subcervical or subtrigonal group of glands which leads to median bar.

The acquired form of hypertrophy is identical with hypertrophy of the prostate and needs no comment.

From a pathological point of view the cases that have not been relieved show either an acute inflammatory process or a hypertrophy.

The one objection to the punch operation—that of hemorrhage—has been to a large extent obviated by the use of a cephalin-coated catheter. The cephalin is dissolved in as small amount of ether as possible and this concentrated solution of cephalin is allowed to drop on the rotating catheter; the ether quickly evaporates and leaves a smooth coat of cephalin. The coating extends from the eye for about three inches back. Thus, when the catheter is in place, pure cephalin is brought in direct contact with the cut surface at the vesical orifice. This local hæmostatic, recently described by Dr. Howell, has been used on all the punch cases during the past six months at the Brady Urological Institute, with the result that practically none of these cases bleed.

Dr. EDWARD MARTIN said that this discussion is limited to obstruction at the neck of the bladder, the part of the prostate palpable through the rectum bend and the urethral length not being largely increased. It is true that obstruction thus placed and conditioned may be due to a median bar, but not always, since there may be a fibrosis of the internal vesical sphincter producing a ring-like constriction. Although there are no completely convincing microscopic studies of this type clinically, there is a hard annular obstruction which can be

felt by the finger, which obstructs the passing instrument and which can be relieved only by section or wide dilatation or both. Obstruction in practically all cases is largely influenced in its degree by spasm and congestion, as this obstruction in the ring cases is more inveterate and lethal than that due to the ordinary hypertrophied prostate which we take out.

The operative attack, of course, is at the site of the obstruction. This we have carried out by fulguration, by the punch—which has not been entirely satisfactory; but most successfully and safely by a suprapubic opening, inspection, palpation and the meeting of the indications, either by removal of adenomatous growth or section of an obstructive fibrous bar always followed by very wide dilatation of the internal sphincter or by multiple sections of a localizing ring.

Dr. Randall spoke of the renal degeneration and atrophy which always accompany obstruction low down and which are factors in hastening the fatal ending, whatever the disease from which the patient suffers. The difficulty in treating many of these cases is that they have never been catheterized, and are not infected. There is no known method, no human skill by which can surely be avoided infecting these cases on the first catheterization. The infection when it occurs travels up into the kidney by the lymphatics with a resulting pyelitis and pyelonephritis to which these congested and damaged kidneys are peculiarly susceptible and from which some of these patients promptly perish. For that reason the cases which have survived their first infection may be better risks than those who have never been infected. And it therefore follows that in the case of a fairly comfortable and ablebodied person there is a perfectly justifiable hesitation in instrumentation of any kind, even gentle catheterization, since this in spite of every precaution may be followed by an ascending and fatal infection. When the obstructive symptoms become urgent this risk must of course be taken.

DR. JOHN B. DEAVER said that he had operated on these cases in years gone by, exposing by the suprapubic method and removing the enlarged portion with the rongeur forceps. He had used the Sir Henry Thompson instrument. He had found that the ordinary rongeur forceps, such as is used in other operations, answers very well. He agreed with Dr. Randall that in these fibrotic prostates or median bar enlargements, one cannot do a total enucleation with the same degree of ease and safety as one can the above mentioned operation. We know how much more grave from the operative standpoint removal of a small hard prostate is in comparison to a large prostate. He had had

no experience with the punch operation. It is doubtless satisfactory in the hands of Randall and Young and in the hands of men who are experts in cystoscopy, and the operation should be confined largely to the practice of those men. The safer method rather than the one proposed by Dr. Randall would be that of suprapubic exposure by which one can actually see the condition and deal with it with less liability of complications.

Dr. B. A. Thomas called attention to a paper in the *Ohio State Medical Journal*, April, 1915, by E. O. Smith of Cincinnati, who discussed the subject of "median bar formation" or obstruction. Smith cited a number of cases and showed excellent pictures of two or three gross specimens similar to some shown by Dr. Randall, in which enlargement of Albarran's glands, causing obstruction, was beautifully shown. Contrary to Dr. Randall's conception, it has been his custom to regard "median bar formation" not as one involving the median lobe of the prostate, a premise which is not generally admitted, but which the essayist this evening states should be considered, including everything obtructive at the vesical neck " with the exception of the lateral lobes." Personally, he did not think that simple hypertrophy of the median lobe of the prostate belongs in the caption of so-called "median bar formation."

He had been accustomed to recognize five types of "median bar formation" or obstruction at the neck of the bladder. They are: (1) glandular; (2) fibrotic inflammatory; (3) fibrotic non-inflammatory; (4) muscular contracture; (5) congenital mucosal fold.

The glandular type of this disease has its origin in Albarran's subcervical or Home's subtrigonal group of glands, but should not include hyperplasia of the median lobe of the prostate. The second and third types are fibrotic in character, and may or may not be associated with inflammatory changes associated with the underlying prostate. The fourth type is that which clinically we are accustomed to consider as a muscular contracture of the vesical neck, possibly the result of neurological or inflammatory affections. This opinion is also held by a number of renowned authorities—Guyon, Marion, Bazy, Frankel-Hochwart, Chetwood and others.

The work of Young with respect to the microscopic study of sections in about 100 cases did not show that the muscular element entered into the condition at all. However, it is possible that by the punch operation enough glandular or fibrotic tissue is not removed to catch the underlying muscle or fibres of the sphincter. The last is the congenital obstruction. This he had never seen but he had no doubt it may occur, simply as a fold of the mucosa at the vesical orifice.

The German urologists in recent years have regarded atrophy of the prostate as a cause of median bar formation or contracture of the neck of the bladder. In a recent article Dr. Randall also seemed to attribute atrophy of the prostate as a cause of this condition. He could not see by any thought of histopathology how atrophy of the prostate can possibly cause such a state of affairs at the vesical orifice. He did not believe it is the cause, although not infrequently atrophy of the prostate is present. Why cannot prostatic atrophy be associated with or the counterpart of the same condition that causes contracture of the neck of the bladder? The importance of " median bar formation " will be realized when it is remembered that approximately 10 per cent. of patients complaining of symptoms of prostatism are cases of *prostatisme sans prostate,* and do not belong to the well recognized group of simple prostatic hypertrophy, in which the treatment is essentially and frequently radically different.

In the proper treatment of the conditions, two thoughts should be borne in mind primarily by the surgeon: First, whether or not syphilis may be present. The second is that to which Dr. Randall alluded, spermatocystitis, as a gonorrhœal sequel. It has been shown by Belfield, of Chicago, that, as a result of seminal vesiculitis with inflammation and infiltration of the base and neck of the bladder, symptoms may arise such as median bar formation causes. Within the past eighteen months he had seen three cases with considerable amounts of residual urine, one with fifteen ounces, with no other possible cause than a definite chronic periseminal vesiculitis. The cysto-urethroscope, although not always all sufficient diagnostically in all cases, is invaluable in differential diagnosis.

He agreed with Dr. Randall that as to treatment each case is a study unto itself. Rectal palpation, to determine if possible the state of the seminal vesicles and lateral prostatic lobes, and in conjunction with the use of the cysto-urethroscope to learn the thickness of tissue intervening between the rectum and vesical neck, is important. Just as in prostatectomy for simple hypertrophy either suprapubically, or perineally, so here with " median bar formation " or obstruction at the vesical neck it is paramount to determine, first, the operability of the patient by any method, and, second, operative procedure best fitted for the particular patient. For the first he recommended more strongly than ever, the index elimination of indigocarmin, than which there is no better, or more reliable test for the determination of kidney function. Reliance mainly upon this and discrimination as to route has obviated a prostatectomy death now for two years and eight months and a mortality rate of barely 3 per cent.

The operative procedures directed to the relief of median bar formation or obstruction resolve themselves into the following: (1) suprapubic cystotomy, followed by removal of obstruction at orifice, either with ordinary cranial rongeur or with Young's punch. (2) Young's median bar excisor or punch operated per urethram, as designed. (3) Chetwood's galvanocautery, through perineal incision. (4) Destruction by high frequency spark (so-called fulguration).

He agreed with Dr. Deaver regarding the method of operation in the majority of cases, that is as described under (1). In those cases where a fibrotic bar exists at the vesical orifice, Young's punch will be of service when the rongeur fails. Used in conjunction with cystotomy, the danger from hemorrhage and infection incident to the punch operation is reduced to a minimum. Employed only per urethram as designed, he believed the danger following the punch operation is greater than that from the open operation, either by the suprapubic or perineal route. He had used Young's punch in a number of cases and in one case was unfortunate enough to have the patient die of embolism within a week after having been considered out of danger. Of course, one cannot say that embolism might not have occurred had the operation been of another kind. However, a number of urologists have reported serious hemorrhages, even deaths, following this operation.

Chetwood's galvanocautery incision of the vesical neck through the perineum has permanently supplanted the Bottini-Freudenberg procedure per urethram, but it too enjoys a rather restricted field of utility, and should be reserved for only the most advanced and intractable forms of contracture of the vesical orifice.

Fulguration or the high frequency spark may be applicable to a limited number of cases, but should not substitute more rational and better procedures. As a rule, even in the glandular type of obstruction, this method is likely to prove unsatisfactory because of the necessarily prolonged and painful course of treatment.

DR. RANDALL, in closing, said that he feared he had been rather vague in describing the median bar, and he confessed he was still a little vague in his own mind regarding exactly what it means. He started out in this work thinking that he had a very definite picture of what he would find. As time has gone on he had had to modify and modify that picture, for as the specimens increased he had found more borderline conditions, and specimens in which, with the naked eye only, it was impossible to say the origin of the tissue causing the obstruction. The work has continually pointed to the need of microscopic study in

order to distinguish the true underlying pathology, and this phase of the subject was started some months ago and is being carried on as fast as the material is obtained.

He had continued to use the term " median bar " because it was the one employed by the man who first recognized and described the condition, but he used it in a very broad sense, covering with it all obstructions situated at the posterior vesical orifice unassociated with hypertrophy of the lateral lobes.

He felt that he had touched rock-bottom in but two places. He had presented four types of obstruction. He had found two types of obstruction at the posterior vesical orifice, the first is fibrous, the second glandular. Each allows of a second subdivision; the fibrous into bars that point (a) urethraward, and those that have an (b) upward-vesicalward-tendency of growth; while the glandular obstructions (call them bars if one will) may either be the (c) hypertrophic nodule or lobe from the subcervical glands, or the (d) thick, rounded bar from the glandular hyperplasia in the posterior prostatic commissure.

Dr. Martin's remarks in regard to the muscular ring contracture are pertinent. One sees them clinically but what they are from the gross pathological standpoint he was not ready to say.

Dr. Thomas had brought out a fair criticism as to why he included the glandular hypertrophies at all. He had done so because, first, they form a definite type of median obstruction, second, because clinically in certain cases it is impossible to say whether the obstruction is of one variety or the other, and, third, because there are borderline cases in which even with the bladder and prostate in one's hand, one cannot determine the character of the obstructing tissue. It was because of such embarrassments that the microscopic study became an essential.

It had been a great pleasure to hear both Dr. Deaver and Dr. Martin sanction the death knell of suprapubic prostatectomy in the cases of so-called " small fibrous prostates." They are not hypertrophies and unquestionably should not be treated as such. They *are* the bar cases, the cases of *prostatisme sans prostate:* the obstruction is definite but in actuality small, and other surgical procedures than prostatectomy can secure complete relief of symptoms.

BOOK REVIEWS

THE CATARRHAL AND SUPPURATIVE DISEASES OF THE ACCESSORY SINUSES OF THE NOSE. By ROSS HALL SKILLERN, M. D. Second Edition, Thoroughly Revised, Philadelphia and London: J. B. Lippincott Company.

This newly revised edition is issued just three years after the first appearance of the work. It was and still is the first work published in English entirely devoted to diseases of the accessory sinuses. The first edition was fully reviewed in these pages. This review therefore will deal chiefly with the new or revised parts of the work. The additions of new matter in the present edition are sufficiently important to be listed in detail from the preface. They are: The treatment of sinus disease in children; the use of the nasopharyngoscope in the diagnosis of obscure conditions in the posterior ethmoid and sphenoid regions; the diagnostic needle puncture of the maxillary sinus more fully explained, with possible dangers and how to avoid them; Canfield's operation in the maxillary sinus is compared with the preturbinal method, with instructions for and illustrations of both the immediate and ultimate effects of operations on the sinuses; a compilation of the American mortalities following the Killian operation on the frontal sinus; complete revision of the chapter on the sphenoid sinus, with description and illustrations of Halle's new operation; a chapter on combined empyema or multiple sinusitis. The entire work has undergone a systematic revision. Certain statements which seemed obscure have been rearranged and amplified with special reference to rendering them more direct and simple. We note that the former index has been elaborated though this in the opinion of the writer might be carried still further.

The first edition of Skillern's book was welcomed by American rhinologists as an important contribution. It incorporated a great part of the very important advances in the treatment of the nasal accessory cavities which had been made during the preceding decade. The book afforded for the first time an opportunity to compare the various operations of different schools set forth side by side for each group of structures.

The new edition brings the work again up to date. The reviewer believes that the additional pages and illustrations incorporate the most important of the many new facts established and new operations devised within the period elapsing since the first edition appeared.

WILLIAM C. BRAISLIN.

THE BREAST, ITS ANOMALIES, ITS DISEASES AND THEIR TREATMENT.
By JOHN B. DEAVER and JOSEPH MCFARLAND assisted by J. LEON
HERMAN. Large octavo, pages 724. Philadelphia: P. Blakiston's
Son and Company, 1917.

This is an encyclopædic work which by reason of the collaboration
of masters in clinical surgery, pathology and anatomy has been made
to embody knowledge and teaching which ranges from the domain of
embryology to the latest suggestions of technic in the removal of neo-
plasms. A full bibliography is given of each topic discussed. One of
the most interesting chapters is that devoted to the anomalies of the
breast. The reader will find gathered together in this chapter an
amount of singular information as to such anomalies which cannot be
found elsewhere, and which is full of curious interest. Special mention
should also be made of the pages devoted to the subject of tuberculosis
of the breast which contain tables giving details of all cases which have
been discovered in literature up to the present time, being forty-eight
primary cases and twenty-nine secondary cases, with a very full bibli-
ography of the subject.

The subject of cysts of the breast receives very full discussion. No
question has been more mooted among surgeons during recent years
than the relations of cystic degeneration (abnormal involution) of the
breast and the development of carcinoma. The following quotation may
be accepted as a very fair statement of present knowledge on the sub-
ject, " It is sometimes urged that both the conditions, carcinoma and
abnormal involution, are most frequent at the same period of life, and
that therefore they are probably connected with one another. We
cannot see the necessity for supposing that two conditions that happen
to coexist must be connected with one another in the relation of cause
and effect. At a certain age the breast is subject to involution which
sometimes becomes abnormal and peculiar. At the same age cancer
develops in the breast irrespective of any cause or condition known,
but the involutional changes are apt to be numerous and diffused, the
cancer quite as apt to be localized. Of course both may be reversed; the
involutional disturbance may be localized and the cancer diffused. In
the present state of knowledge the questions cannot be answered. We
cannot be certain of the relation of the one morbid process to the
other. The case is not proven, but the matter is of the utmost impor-
tance in its surgical application, for it is upon the theory that abnormal
involution is the precancerous stage of cancer that many surgeons
are now advising and treating their patients."

The practical conclusions of the authors are expressed in the fol-

lowing, among other opinions with which the chapter devoted to this subject is concluded:

" Carcinoma may accompany or follow abnormal involution in about one case out of ten. No one has seen the transmutation of abnormal involution into cancer. Exaggerated fear of the occurrence of carcinoma after abnormal involution has led to unnecessary mutilation of patients by the removal of many breasts that show no important disease. Instead of amputation without examination, the breast should be investigated by plastic resection. If normal it should be let alone; if slightly and locally diseased, the diseased areas should be excised. In cases of badly diseased breasts, simple amputation is indicated. In cases of carcinoma, radical amputation should be performed."

The chapter devoted to the subject of carcinoma contains fully illustrated details of the various methods of technic which have been devised to carry out present accepted ideas of the diffusion of the disease, and the requirements for its radical extirpation. Dr. Deaver, in devising the details of his own method, has been influenced by the teachings of Handley with reference to the extension of the disease along the deep fascial planes.

The book as a whole is a most important addition to the literature of diseases of the breast, and will always remain of value as a full presentation of present knowledge and practice in such diseases.

LEWIS S. PILCHER.